OCTOBER 1973 60 CENTS

Popular Science

THE What's New MAGAZINE

PHONY-MONEY DETECTORS

Can They Keep You from Getting Stuck with Counterfeit Bills?

Which half is the phony?

NSIDE THE '74 CARS

Uniform-Height Bumpers Take Side Impacts, Too

Picking Your New Car for More M.P.G.

Electronic Ignition —Stronger Sparks and Surer Starts

Seat Belts That Won't Take No for an Answer

ehind-the-Scenes tory of the ESCUE OF SKYLAB

o Help Relieve the nergy Crunch, Now It's UPERBATTERIES

0-Page Special Section OW YOU CAN BEAT HE HOME-HEATING UEL SHORTAGE

irst Monthly Winner! S One-Weekend roject Competition

BOARD THE ONCORDE SST

ou'd Never Believe t's Mach II

lus 33 other xciting features -Contents p. 6

12 things you should know about the '74 Ford before you buy any pickup.

1 Ford cabs are quiet, carlike, roomy. Inside width of 66 inches allows three big men to ride relaxed. Padded dash is standard; glove box is large and placed high for easy use (note below).

2 Optional air conditioning is built right into the instrument panel to improve air circulation and give passengers full legroom.

Works like a truck. Rides like a car.

A better idea for safety: Buckle up.

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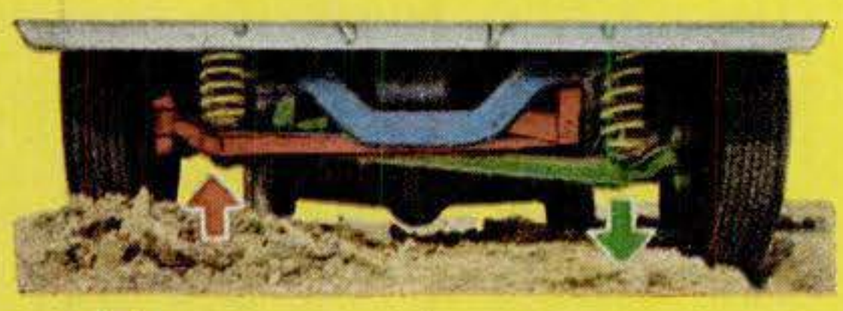
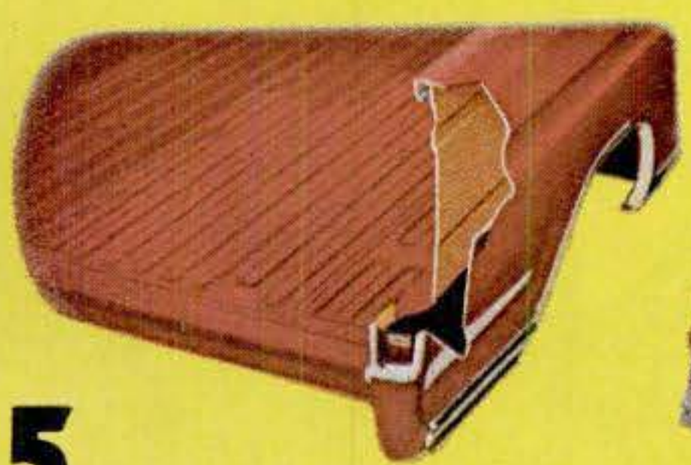
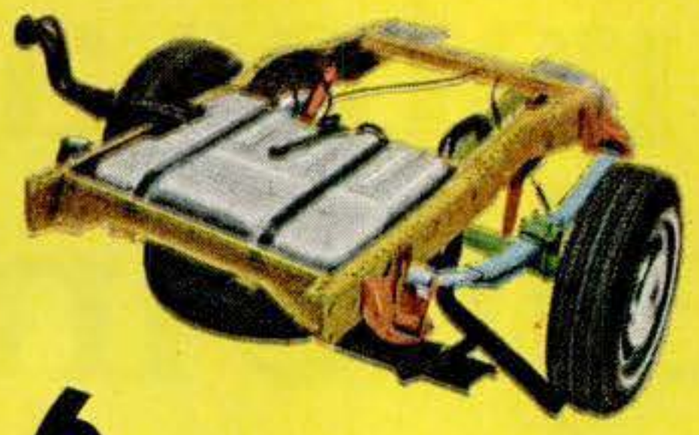
3 Behind the seat is a hidden storage space 5½ feet wide. It's big enough to hold tool boxes, golf bags or other gear.



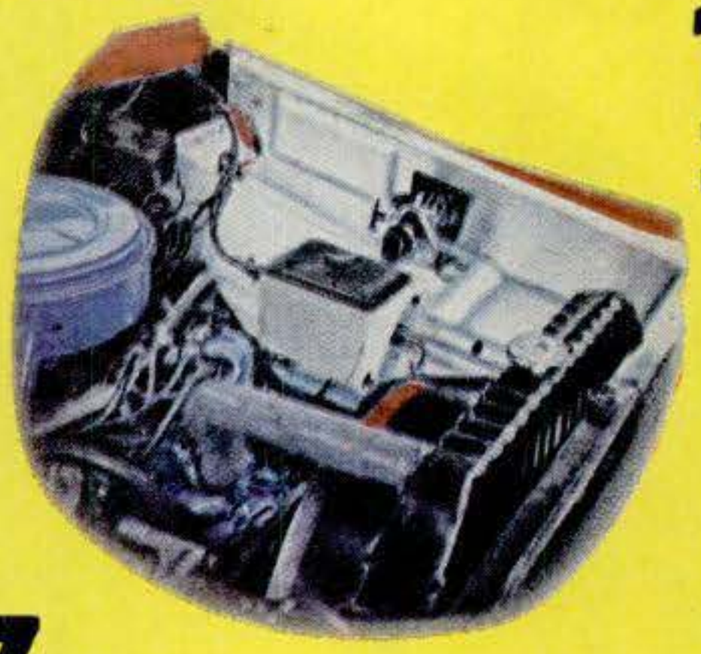
4 Only Ford pickups have Twin-I-Beam front suspension for truck strength plus smooth carlike ride. Two front axles let wheels step over bumps independently.



5 Sides of the cargo box are double-wall their full depth. All told, over 200 sq. ft. of surface is zinc-coated to resist rust.



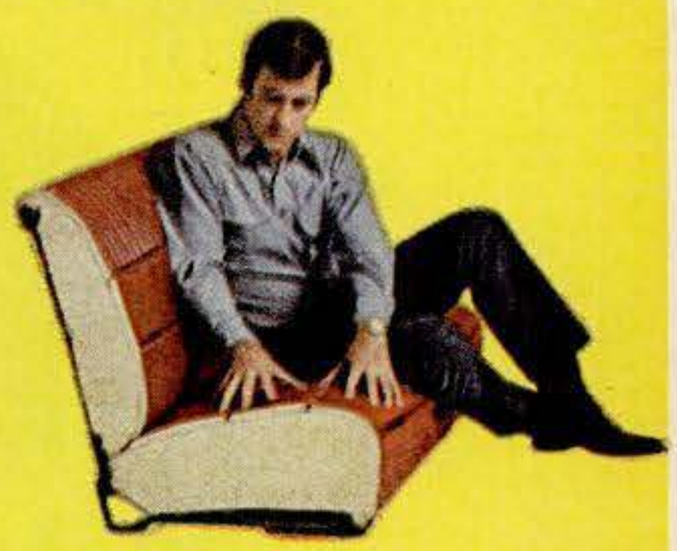
6 Ford took the gas tank out of the cab and put it in a protected position under the box, between the frame rails.



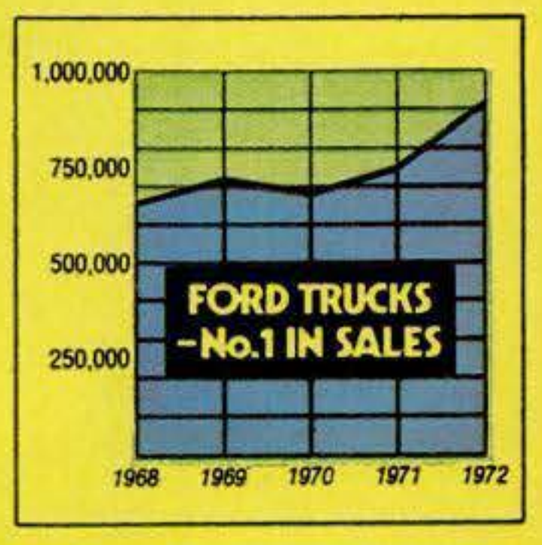
7 You can choose a Ford Six or, for heavy loads, V-8's up to 460 cu. in. Note galvanized splash shield next to engine.

8 Ford pickups come big as 10,000 lbs. GVW, like this F-350 Super Camper Special, to meet all your pickup needs.

10 Front disc brakes are standard on 2-wheel-drive pickups, including power brakes on models rated over 5,100 lbs. GVW.



11 Even the standard cab gives you the solid comfort of a full-foam seat 7 inches deep. Seat adjusts 5 inches for best position.



12 Better ideas for buyers have put Ford trucks first in sales for five straight years through 1972. Industry records show Ford Dealers have sold over 200,000 more trucks than the next make.

OVER 92 OUT OF 100 FORD TRUCKS BUILT IN THE LAST 12 YEARS ARE STILL ON THE JOB . . . ACCORDING TO OFFICIAL INDUSTRY FIGURES FROM R. L. POLK & CO.

9 Official industry figures from R. L. Polk & Co. prove the durability of Ford trucks. For a long-term investment, see your Ford Dealer now.

FORD

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What's New NEXT MONTH

For Your Next Car— Air Bags or Seat Belts?

We're Going Metric: Here Comes the New "Yardstick" in Your Life

New Comet Promises Sky Spectacular of Century

NASA's Hypersonic X24B Points Way to Flight at Five Times Speed of Sound

Troubleshooting Your Car's Electronic Ignition

OCTOBER 1973
Vol. 203, No. 4

EDITORIAL OFFICES
355 Lexington Ave., New York, N. Y., 10017

PUBLISHED MONTHLY by Popular Science Publishing Co., Inc., 355 Lexington Ave., New York, N. Y. 10017.

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One of a continuing series. **Remington Reports**

Can a hunter learn anything from a skeet shooter?

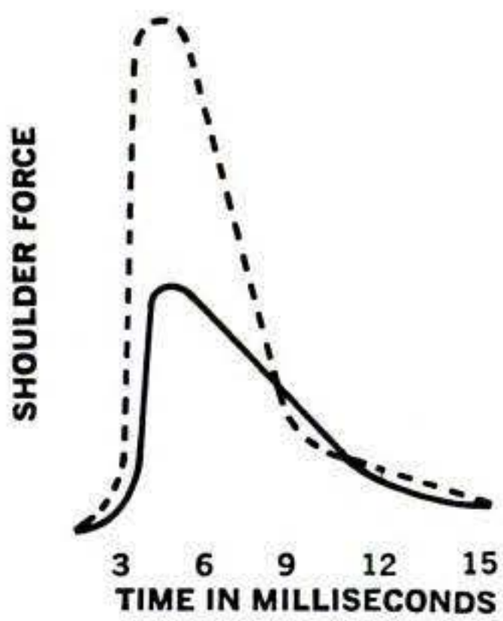
"Yes", say Remington experts . . . including why our Model 1100 Automatic Shotgun—the top gun in skeet—is tops in the field!

It's said some hunters don't shoot skeet because they can't eat clay pigeons. But, if you don't count taste and plumage, there is virtually no difference between a clay bird and a game bird. As far as a wing shooter is concerned, both are moving targets with the same problems of pointing, swing and lead.

If you go hunting with a skeet shooter, don't bet against him. Because skeet actually came from the field. It was developed about 50 years ago by the late Charles E. Davies, at Andover, Mass. He was an avid upland game hunter and wanted to practice shots he had missed while hunting. And don't forget that a dedicated skeet shooter may shoot at *thousands* of clay birds a year, each one simulating a game bird in flight. So it would take a really tricky bird to fool him. Naturally, like the hunter, the skeet shooter wants a shotgun that points naturally, patterns consistently and is reliable. That's why you'll find so many Model 1100's in the hands of so many skeet shooters, especially at championship events.

When you hold an 1100, you can tell it's different. The 1100 is designed with "muzzle preponderance"...balanced so there's weight at the muzzle. We believe this helps you hold an 1100 steadier than a shotgun without it. And we think it helps you point easier and faster and swing more smoothly, too.

Remington designers have given the 1100 a rate of fire they feel is optimum. Pull the trigger, and the 1100 ejects the empty hull and chambers a fresh shell automatically. You can fire again as soon as this cycle is complete. But, if the cycle takes too long, you may lose the chance for a quick second shot. And if the cycle is too fast, you're apt to shoot too soon...and miss. Remington's designers believe that the 1100's rate of fire is an ideal compromise between those two extremes.



The dotted line shows the recoil force from a typical fixed breech shotgun action (Shotgun weight: 7 lbs. 2 oz.). The solid line shows the recoil force delivered by a Model 1100 (Weight: 7 lbs. 12 oz.). Checked and proved by computer, the Model 1100 delivered 55% less force than the fixed breech gun. Each gun tested with a 12 ga. magnum load.

The 1100 really reduces recoil sensation. Remington has found a way to "soften" recoil sensation by distributing it. The chart shows how the Remington Recoil Reduction System works by plotting shoulder force against time. The dotted line shows what happens when a 12 gauge magnum load is fired in a fixed breech shotgun of approximately the same weight as the Model 1100. The recoil quickly rises to a high peak. The solid line shows the recoil when the same load is fired in an 1100. The line starts to rise but the system traps some of the recoil force, releasing it later. Thus you feel a "push" instead of the usual jolt you can get from a competitive gun.

If you like good-looking shotguns, you'll like the looks of an 1100. Those looks are functional, too. Our RK-W wood finish does more than dress up the stock. It's tough and scratch-resistant. Our "vibra-honing" metal finish not only permits a deeper, richer blueing...but it also makes the working parts smoother so there's more glide and less friction.

The Model 1100 comes in 12, 16, 20, 28 and 410 gauges. And there are optional interchangeable barrels within each gauge. In addition to the standard models, there are three-inch magnum 12 gauge, two lightweight 20 gauge models (one a magnum), deer models with rifle sights, and trap and skeet versions. Trap, skeet, and field left-hand models are also available. Prices start at $189.95*.

Use the shells we test the 1100 with. The champions do.

Here's something else you can learn from skeet shooters: use Remington shells. Consistently, winners at the world skeet championships have depended on the top performance built into every Remington shotgun shell. Skeet shooters know their ammo as well as their shotguns.

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Model 1100, 12 Gauge, Vent. Rib $214.95*

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THE What's New MAGAZINE™

OCTOBER 1973

Founded in 1872
Vol. 203, No. 4

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355 Lexington Ave., New York, N. Y. 10017

PUBLISHED MONTHLY By Popular Science Publishing Co., Inc., J. M. Hadley, President, 355 Lexington Ave., New York, N. Y. 10017.

Microfilm editions are available from University Microfilms, Ann Arbor, Mich. 48106.

ADVERTISING OFFICES
New York: 355 Lexington Ave. (10017), Tel. 212-687-3000; Chicago: 401 N. Michigan Ave. (60611), Tel. 312-527-0550; Detroit: 1716 Fisher Building (48202), Tel. 313-872-7060; Los Angeles (Pacific West Coast): 3550 Wilshire Blvd., Suite 908 (90005), Tel. 213-380-1936.

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1974 Oldsmobile Omega.

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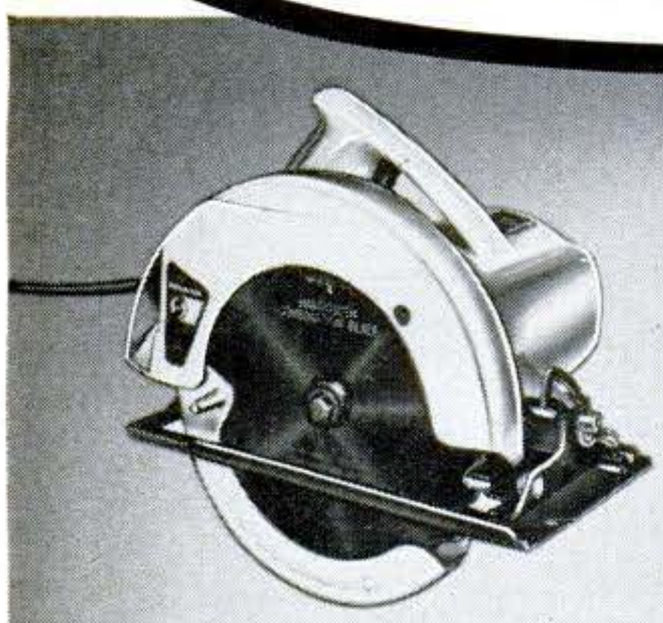

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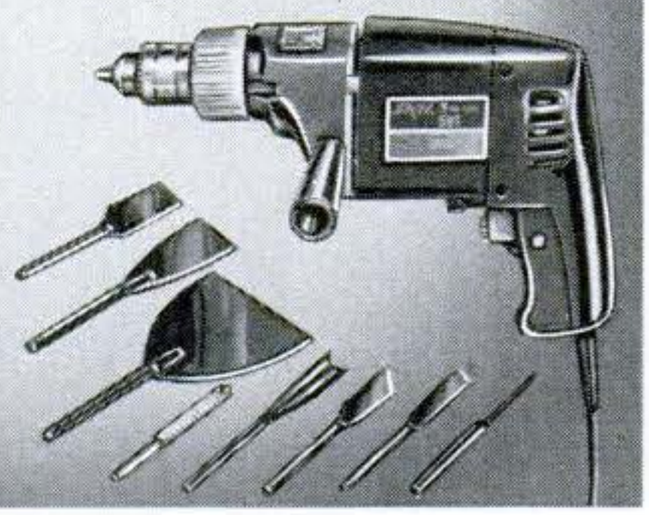

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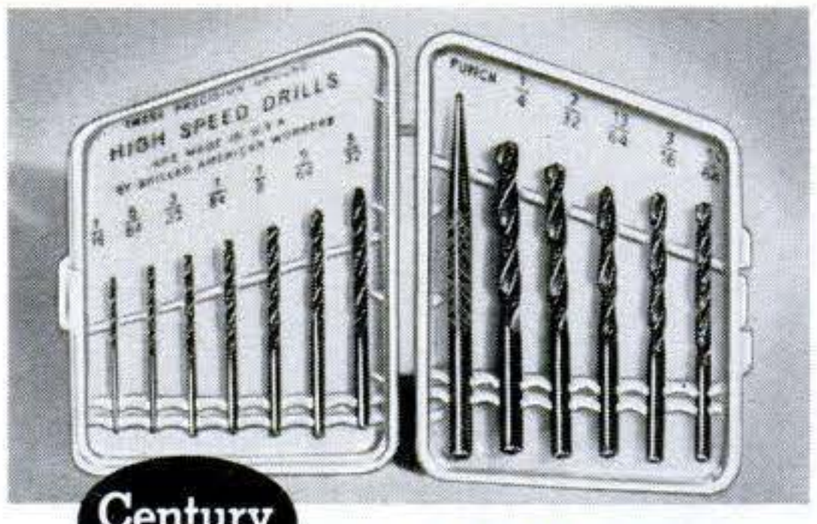

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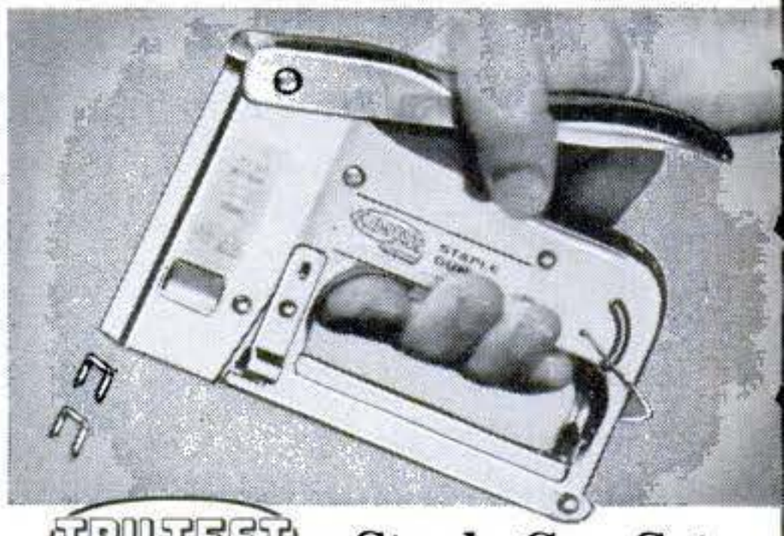

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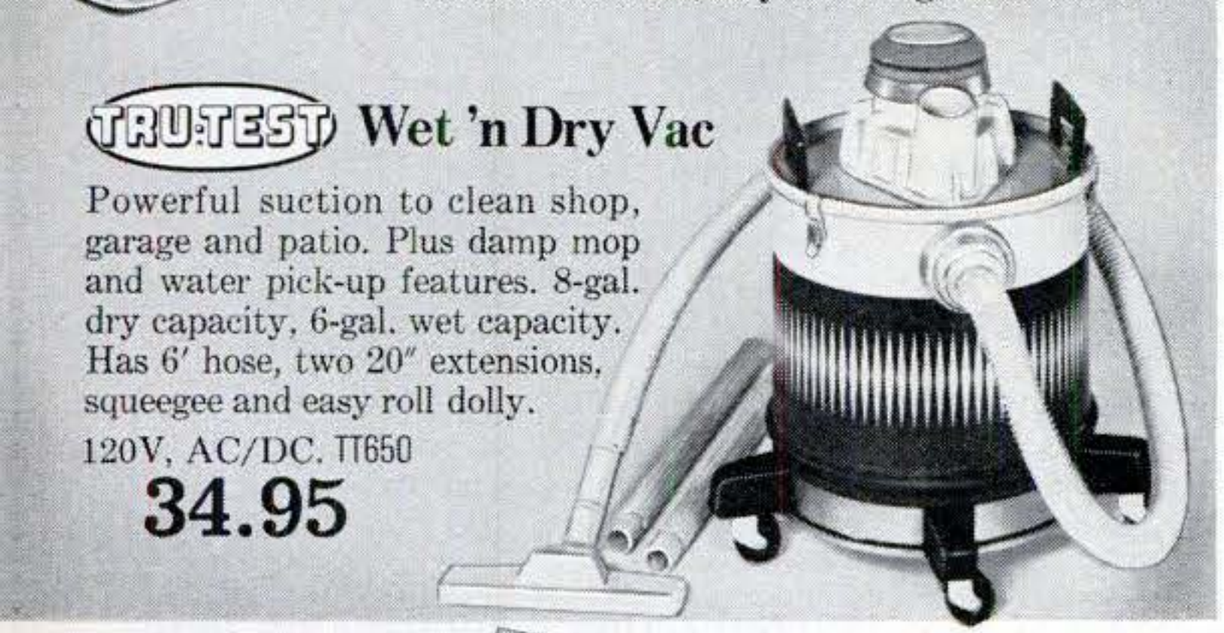

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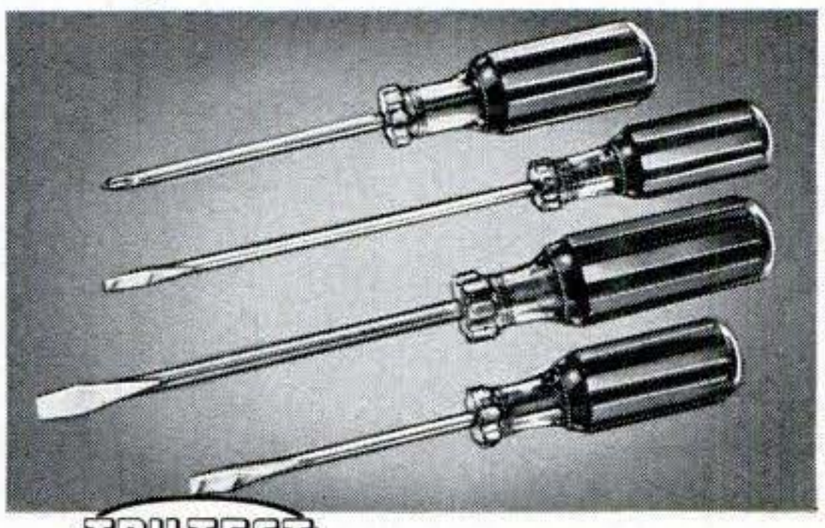
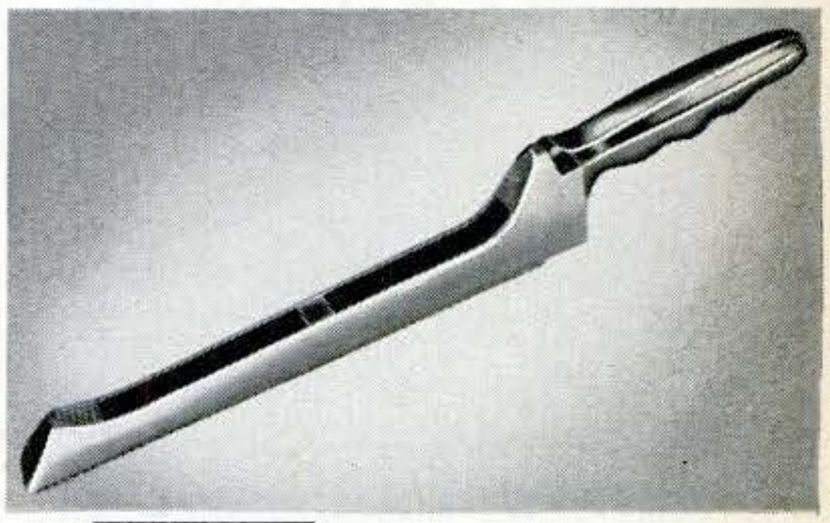


TRU-TEST Supreme
Screwdriver Set

4-pc. set with alloy chrome vanadium blades, rustproof finish. Includes 3 mechanics and a #2 phillips type tip. Cushion grip for comfort, extra turning power. TS4GC **3.77**



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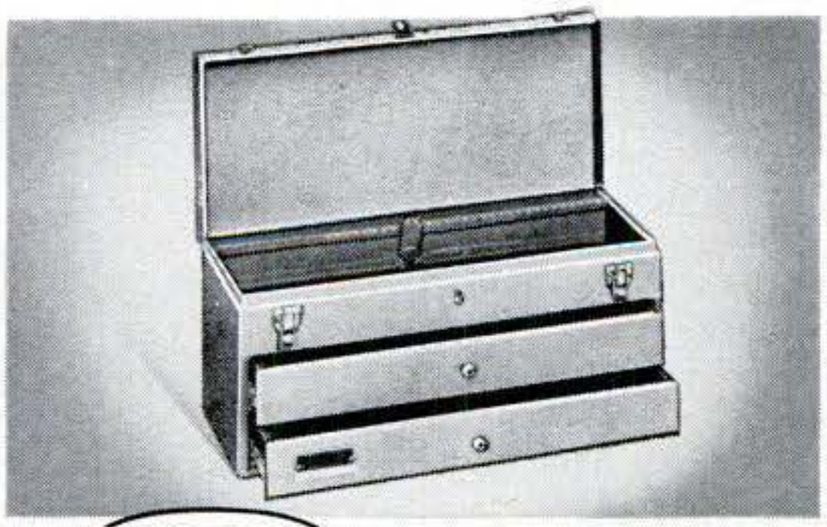

TRU-TEST
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Maximum storage in compact unit. All electric-weld construction. 1-pc. hinge, roomy top till. 2 easy-pull, spill-proof drawers lock when lid closes. 10 x 22 x 9½" overall. TT902 **13.55**

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Space-Maker

At-a-glance organizer for small parts, tools and tackle or sewing and household items. Baked-on finish on sturdy steel frame. 27 drawers in 3 sizes.
8.99

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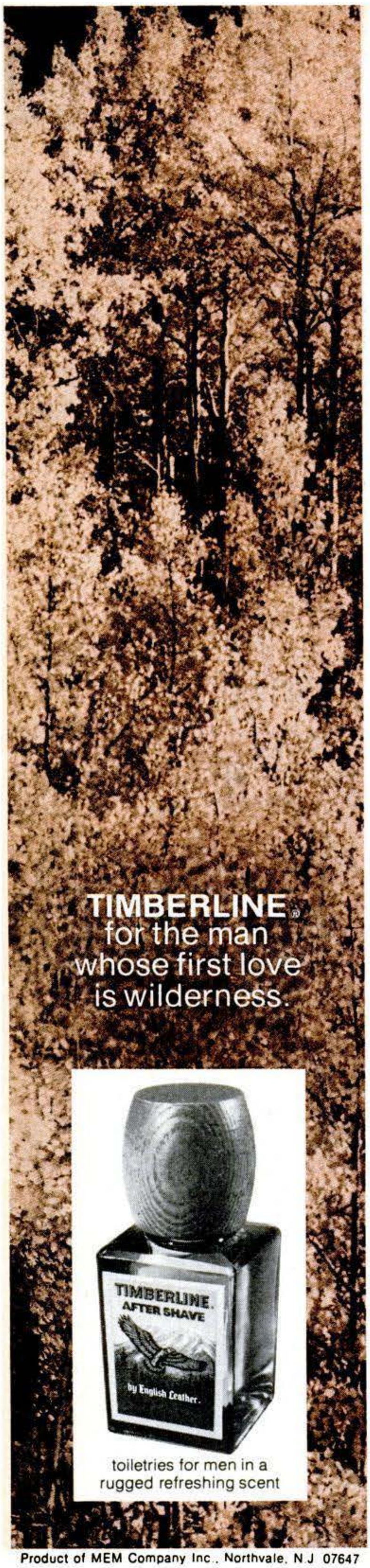

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PS Readers Talk Back

Where you voice your views . . . and the editors do the listening

BD-5 homebuilts

Your article "At Last . . . the *Real* 200-mph, 38-mpg, $2965 BD-5" [Aug.] is misleading. Let the prospective buyer be aware that his money will be tied up for quite some time while Bede delays and delays, shipping piecemeal, so that back orders of small but essential materials prevent completion of any one aspect of the plane. I ordered in early October 1972, received two packages in late April, and cannot complete anything. But I still like the idea of the plane.

R. W. LONG, Tallahassee, Fla.

. . . Jim Bede and his beautiful BD-5 don't need the assistance of the backhanded, vicious garbage your reporter saw fit to mar this article with. Characterizing the homebuilt airplane situation as a "slapdash business" run by "geniuses selling sketches" to people whose skills "can't be trusted" to make parts such as "ribs, spars, channels, fuselage bulkheads, and trim-tab panels" is wholly unjustified. A trip to the Oshkosh convention by a more responsible reporter, where over 500 homebuilts (with a safety record equaling commercially built planes) should be an eye-opener for your readers.

BRUCE FORTIER, Essex, Mass.

Gas-shortage solution: taxes?

If there's truly a gas shortage in the U.S., there's only one way to correct it. Place restrictions on autos with engines bigger than three liters. A two-liter engine will get more than double the mileage of a 400-cubic-incher at the proposed reduced speed limits. Legislation should be initiated to impose a tax on any auto with an engine above 1.5 liters. The tax would be minimal up to three liters and more severe above that. The tax money could be used to help fund the Environmental Protection Agency. (Our bonus would be less fuel used; less pollutants in the air.)

DOUG DENISON, Monrovia, Calif.

A happy Manta builder

I'd just like to tell you that I built a Manta from your article "Speedy Sailcars Take Off in the West" [Mar. '72]. It cost under $100 as I obtained a Dacron sail from a friend, used CPVC pipe for the booms, and made a few other money-saving modifications. After capsizing it once, I might also add that now I take your advice [PS Readers

Talk Back, Aug.] and wear a crash helmet. This winter I plan on trying to convert her to an iceboat.

PETER HEFTLER, Saline, Mich.

Trail riding a bummer for land?

"Have Your Fun and Preserve the Wilderness, Too" [Aug.] is the most irresponsible piece ever published in your magazine. The author proceeds to sound concerned with the wilderness, then illustrates his real interest with color photos and captions that contradict everything he says in the text. "How to cross over a log" does not indicate keeping to established trails. "Stream crossing can be fun" does not indicate a sincere concern for erosion. "Fun" is the only truthful concern of trail-bike fans. This article is nothing more than a cheap cover-up. I can no longer condone PS's defense of trail bikes and off-road vehicles almost every month.

ROBERT GRANGER, Fort Bragg, Calif.

. . . Great job on the trail-riding story. Finally, someone does an article on this sport keeping the environment in mind. Now let's see some more stories in this area—camping, exploring wilderness terrain—with the proper respect shown for the land that we should have had 20 years ago.

J. HAMMER, Port Jervis, N.Y.

Continuing Alaskan oil hassle

I wish to reply to M. M. Brantly's letter in PS Readers Talk Back [July]. His opinion is a simple-minded attack on environmentalists for blocking the building of the pipeline on account of "a few caribou." But the controversy rages over the

Continued

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King or Super King

- *Naturally grown menthol.*
- *Rich natural tobacco taste.*
- *No harsh, hot taste.*

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

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SUPER KING: 21 mg. "tar", 1.5 mg. nicotine, KING: 19 mg. "tar", 1.3 mg. nicotine, av. per cigarette, FTC Report FEB. '73.

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method of exploitation. The oil companies naturally wish to exploit the oil reserves on a low-cost, high-profit basis. Past experience has taught us that the cheapest way is rarely the best. The proposed pipeline route runs through a zone of high seismic activity. This poses a potentially serious problem of pipeline ruptures and spills of untold gallons of oil on an extremely fragile Arctic ecosystem.

JOHN SCHEER, Bridgeport, N.Y.

VW changes slated

I was amazed to read in The View Down the Road [Aug.] that Volkswagen would do away with their air-cooled engine but even more amazed that you would remark that water cooling is "infinitely superior." After millions of Beetles have traveled billions of miles in all climates with great success, how could water cooling possibly be an improvement? What happened? Did the great monopoly buy into Volkswagen?

F. H. SUTTON, Los Angeles, Calif.

Another engine-run-on fix

In the article "Does Your Engine Run On When Switched Off?" [June], the author should have mentioned another possible cause of engine run-on for cars equipped with an idle-stop solenoid. If the ignition is switched off while the choke system fast-idle cam is engaged, the throttle valve will remain wide open even though the idle-stop solenoid is de-energized. This cause of run-on most often occurs when the accelerator is depressed and released before starting a warm engine, which may load the fast-idle cam, and then switching off the ignition before the cam is unloaded.

FRED SOBOTKIN, New York, N.Y.

Sealing your door

Thanks for the article "Total Security with a Pre-Hung Door" [June]. We have had a number of inquiries from your readers and have shipped several samples to them. The article did have one error, however. The material is not vinyl, but rather a copolymer and has been proven in five years of field service as far superior to vinyl. It is not affected by cold or heat.

JAMES CRESSY, Schlegel Mfg. Co., Canandaigua, N.Y.

The vinyl reference in caption is in error; the Polyflex strips for top and sides are copolymer. But the door bottom is rigid vinyl with urethane-foam strips attached.

Even help box needs help

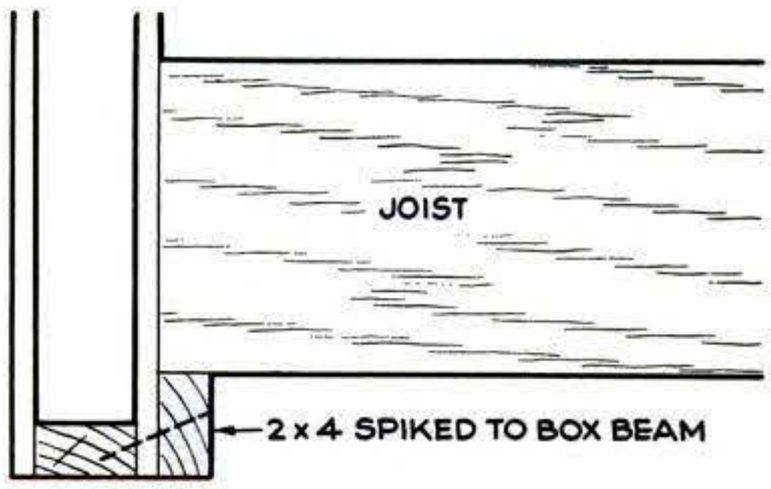
"The Highway Help Box—No Wires, No Batteries" [Aug.] is a great technological advance. The author cites a successful year's test along I-495 in Mass., but he should have checked out the system already in use around Washington, D.C. Those boxes sent signals okay, but one newspaper reported it often took four to six hours to get assistance to a stranded motorist. False alarms, vandalism, and the lack of enough county and state police to respond immediately to a call, greatly decreased the effectiveness of the boxes. The box is only the first step; local communities must develop an adequate response network, and prosecution of misusers must be severe enough to deter costly false alarms.

PETER WARREN, Chicopee, Mass.

About that floor . . .

"Stacked Box Beams: The Super Strong Way to Build" [Aug.] was most interesting. However, I find one disconcerting omission. Where and how are the 2-by-12 floor joists placed, secured, or hung, on both first and second floor?

THOS. B. FAUNCE, Santa Barbara, Calif.



Floor joists for the cottage rest on a 2-by-4 lip spiked to the box beam. The joists are spiked in place on this lip and reinforced with bridging. Same thing goes for the second floor. This gives seven-foot ceilings on the first floor—plenty for bedrooms. Upstairs, ceilings rise from seven to over 12 feet at the high end.

Red ain't dead

I disagree with much of your article "Is There a 'Best' Color for Your Car?" [July]. Mostly, I see red better than author Ed Fales. As a car dealer I notice that red cars going across the auction block nearly always command $100 more. A red car attracts a lot of attention to itself and to the car lot. It's funny that the word red appears more times in the article than any other color and six out of eight photos feature a red car. Red is worth bread, and Fales is pale.

S. P. CLIFFORD, Benzonia, Mich.

Want to get something off your chest? Write "Readers Talk Back," Popular Science, 355 Lexington Ave., New York, N.Y. 10017

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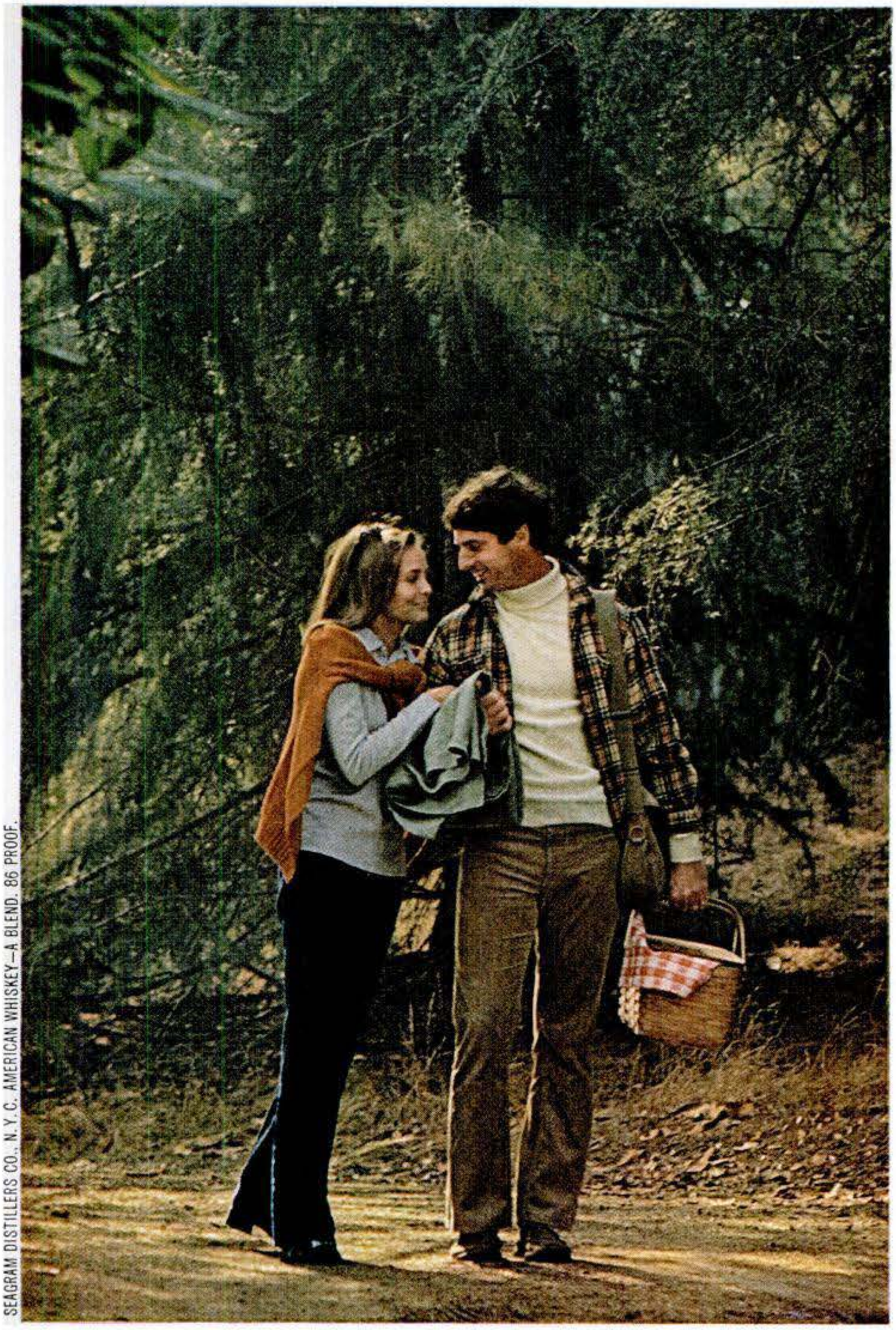
The Seven 'n Cider.



"You tired?"
"Just a little."
"Want to stop?"
"Okay."
"There. That's a nice spot. By the big pile of leaves."

So while she unpacked an autumn kind of picnic, he put together an autumn kind of drink.

In went a jigger of Seagram's 7 Crown, over a healthy handful of ice. Then, fresh apple cider, right up to the top.

Garnished with a thin slice of apple, and that was that.

"Hey, your egg salad is really great."

"Your Seven 'n Cider is terrific too!"

"I'm glad we stopped."

"So am I."

Seagram's 7 Crown.
It's America's whiskey.

The Seven 'n Cider. 1½ ounces Seagram's 7 Crown. 6 ounces fresh, sweet apple cider. Stir over ice.

SEAGRAM DISTILLERS CO., N.Y.C. AMERICAN WHISKEY—A BLEND. 86 PROOF.

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In the air (left) or on a sandy incline (above), the Rokon 340 is equally at home, author Hill reports. Strong, sturdy frame and excellent suspension contribute to the bike's fine handling characteristics. In sand and mud, where you want plenty of traction, not wheelspin, the 340 is ideally suited.

Rokon Automatic: the Bike of the Future?

Starting the Rokon's 335cc Sachs engine is done by pulling a rope cord and holding one hand on the front brake to keep the motorcycle from accidentally leaving you behind.

Pushing motorcycles is never fun, but if the 340 runs out of gas or gets stuck, the Salsbury torque converter automatically shifts to neutral at idle or when engine is shut off.

At a quick first glance this may look like an ordinary motorcycle. It's not

By RAY HILL
PHOTOS BY RAY AND MAIREAD HILL

In Keene, N. H., there's a little motorcycle company called Rokon. Until recently its claim to fame was that from its doors rolled Trail-Breakers—possibly the weirdest and ugliest two-wheel vehicles made. Also machines that (because of their variable-ratio transmission, low-psi tractor-treaded tires, and two-wheel drive system) can negotiate just about any terrain there is—from cold arctic tundra to hot mushy swamps [PS, Sept. '71].

Six months ago, after two years of prototype testing, Rokon introduced the RT340, an off-road motorcycle as radical in design as the Trail-Breaker. The 340 has features never before seen on a production enduro bike. It's a little ugly, too. And it's one of the finest off-road machines I've ever ridden.

What makes it so unusual?

- A Salsbury torque converter that eliminates transmission gears, making shifting a thing of the past. When the engine is accelerating, the torque converter permits the engine to stay constantly at its maximum torque curve for top performance.
- Spokeless alloy wheels made primarily of aluminum and magnesium. They're lighter and stronger than conventional wire wheels. Adjusting or replacing spokes is never necessary.
- Hydraulic disk brakes front and rear. The 340 has one of the best braking systems available today on an enduro bike. I got quick, fade-free stops every time.
- An all-position diaphragm carb. If you fall off the bike, it'll still be running when you pick it up and climb back on, saving you the trouble of restarting the engine.

The 340 performs amazingly well. At speed over the rough stuff, I never experienced the kind of vibration common among many off-road

Continued

ROKON SPECS

Engine	2-stroke Sachs
Displacement	335cc
Horsepower	37 @ 6500 rpm
Compression ratio	11.8:1
Carburetion	38mm diaphragm
Transmission	Torque converter
Intermediate reduction	3-row chain, 1.732:1
RPM @ mph	6500 rpm @ 83 mph
Ignition	Bosch magneto
Maximum torque	28 ft.-lb. @ 6000 rpm
Frame	tubular, double loop
Suspension	Betor, 7" travel front, 5-way adjustable, rear
Brakes	11" disks
Gas tank	3.5 gallons
Weight	270 lbs. dry
Cost	$1495

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1974 MERCURY COUGAR XR-7

In size, this new breed of Cougar is like Grand Prix and Monte Carlo. In every other way, it's like nobody else's car.

You're looking at the all new Cougar for '74. It's more than a new car. It's moved up one whole class. In fact Cougar is the only new choice among the mid-size personal luxury cars.

There's new styling, inside and out. New dash with tachometer and hooded gauges mounted in deeply padded vinyl. Elegant new opera window. Distinctive new Landau roof. Steel-belted radials. All standard. There's power steering. And front disc brakes, automatic floor shift and bucket seats, also standard. Plus the same type suspension system as Lincoln-Mercury's most expensive luxury car. Other features shown are optional.

And along with Cougar's new size class comes a whole new class of comfort for you. Because we felt this much luxury deserved a little more room.

MERCURY COUGAR

LINCOLN-MERCURY DIVISION Ford

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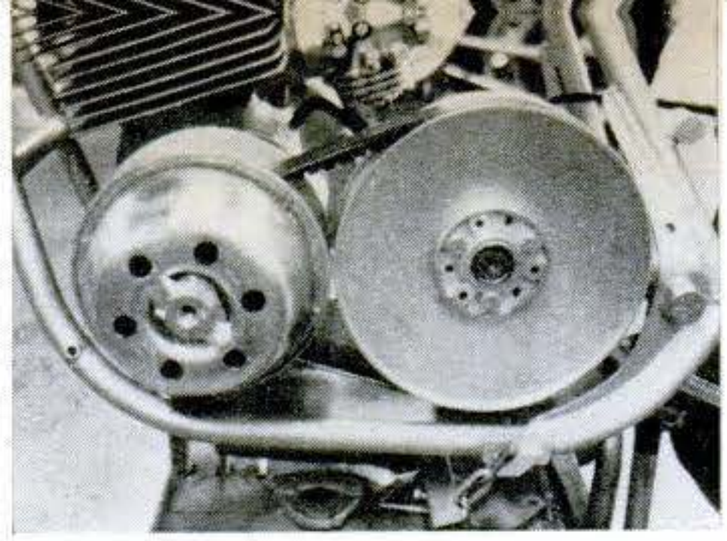
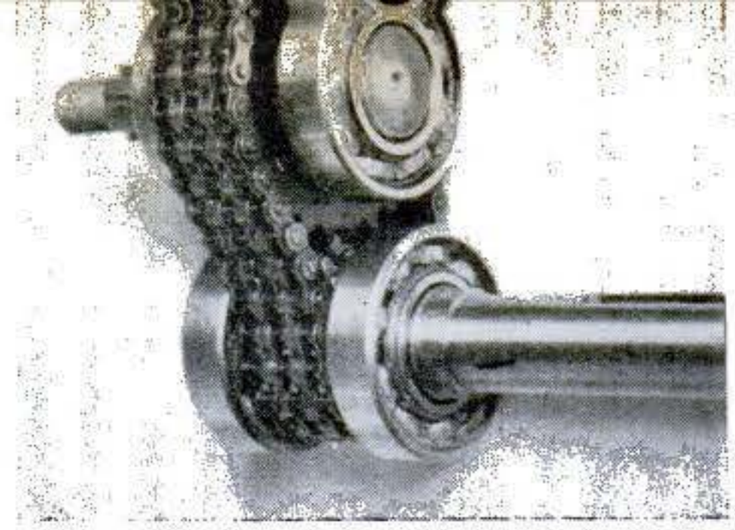
machines. Handling is superb. The engine has plenty of power, and the torque converter does a fine job of transmitting it to the rear wheel.

The converter is similar to that found on snowmobiles.

If you like enduro riding, you'll like this bike. Soon you might see other bike makers copying Rokon's transmission approach—on both street and dirt bikes. PS



Salsbury torque converter engages at about 2700 rpm, and allows the 340 to go from a standstill to about 90 mph without shifting gears.



Reduction gears transmit power from the torque converter to the rear wheel via a standard drive chain. Gears are permanently sealed.

Superior braking that's provided by the front and rear disk brakes is necessary because the Rokon 340 does not have the holdback of a motorcycle with a conventional gearbox.

Alloy wheel is a lightweight; with tire mounted and inflated it's easily held by the author's wife. Although light, these wheels are exceptionally strong.

Sachs engine, originally designed for snowmobiles, provides plenty of power for the 340. Rear brake pedal, beneath rope starter, pivots from front, lessening any chance of its getting bent in rough riding.

This little Pocket can stop a backhand, a sidestroke, leaps, bounds, even a gallop.

The Kodak pocket Instamatic 40 camera has a lot of stopping power. In bright sunlight, its electronic shutter takes big, sharp pictures or brilliant color slides at a fast 1/225 of a second.

The Pocket 40 sports an f/8, 3-element lens that focuses as close as three feet. It even has automatic CdS electric-eye exposure control.

The Pocket 40 will cost you less than $68. And there are five other Pockets to pick from, starting at less than $23.

Prices subject to change without notice.

Kodak pocket Instamatic® cameras.

Kodak

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Sub-compact. Full size. Which demands more from its motor oil?

At today's expressway speeds, little car engines strain to keep up with the big guys. That raises the oil temperature. Today's big cars are usually loaded with power options that also raise the oil temperature. And heat is the main reason oil deteriorates. Today you have to name your oil. By type. By S.A.E. grade. By brand.

Ten years ago, you rarely had to think about oil temperatures. Today you do. Thinking about it may help prevent an unnecessary repair bill.

It doesn't matter what size car you're driving. Even with a modest number of power extras, your new little car can generate some severe crankcase temperatures. Emission controls are one reason. Also the strain of high speeds on little engines, especially on a hill. The harder an engine works, the hotter the oil gets.

Full-size cars run hotter, too. They're loaded with heat-raising options. Some examples: Automatic transmission ups oil temperatures by 10-15° F. Air conditioning adds about 10° F. Power steering, about 10°F. Plus, in new cars, a 15-20°F. boost from emissions systems. And if you're hauling a trailer, change the oil even more often.

What all this means is that your engine oil temperature may be running close to or over 300° F., compared to about 180° F. 10 years ago.

In short, heat is now an oil's worst enemy. So what should you do?

First, read your owner's manual. And change oil just as frequently as it says to. Also note the cautions about severe operating conditions such as dusty areas and short trips in extreme cold.

Second, have your oil level checked more often. Every time you fill up with gas, in fact. Some oil burn-off is normal—but the amount varies from car to car, even when they're the same size and the same year. And keeping the crankcase full helps keep the oil cool.

When you check and add oil yourself:

1. Choose a level spot—not a sloping driveway.
2. Turn the engine off. Wait a few minutes.
3. Fill to the full dipstick mark, but not beyond.

Third, watch your oil warning light. At start-up, it flickers on for a moment or so, until the oil flow is normal throughout the engine. If the light stays on, switch your ignition off immediately and get help. If the light goes on when you're driving, pull over as soon as it's safe. Maybe it's just your oil that's low. Or there may be a more serious problem. Answer: Wait for a professional to get you going again.

Fourth, be sure to use a premium oil. An oil that's fortified to handle this severe heat. For your peace of mind, ask for Quaker State Motor Oil. Quaker State is refined only from 100% Pure Pennsylvania Grade Crude Oil, the world's choicest. And Quaker State is fortified with a blend of additives, scientifically selected to retard oxidation, clean and disperse harmful deposits and to neutralize harmful acids.

Just ask for Quaker State Motor Oil by name. For your peace of mind.

Quaker State your car to keep it running young.

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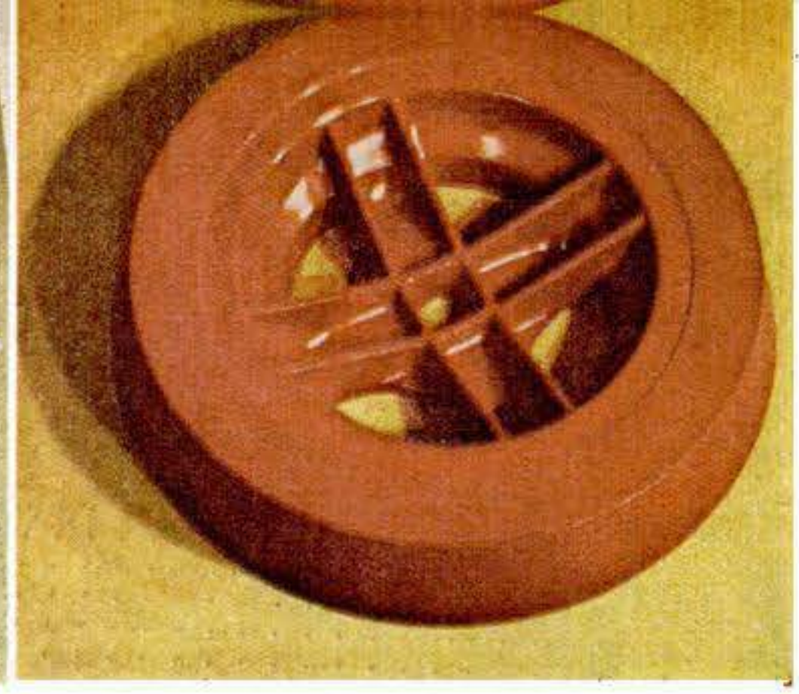
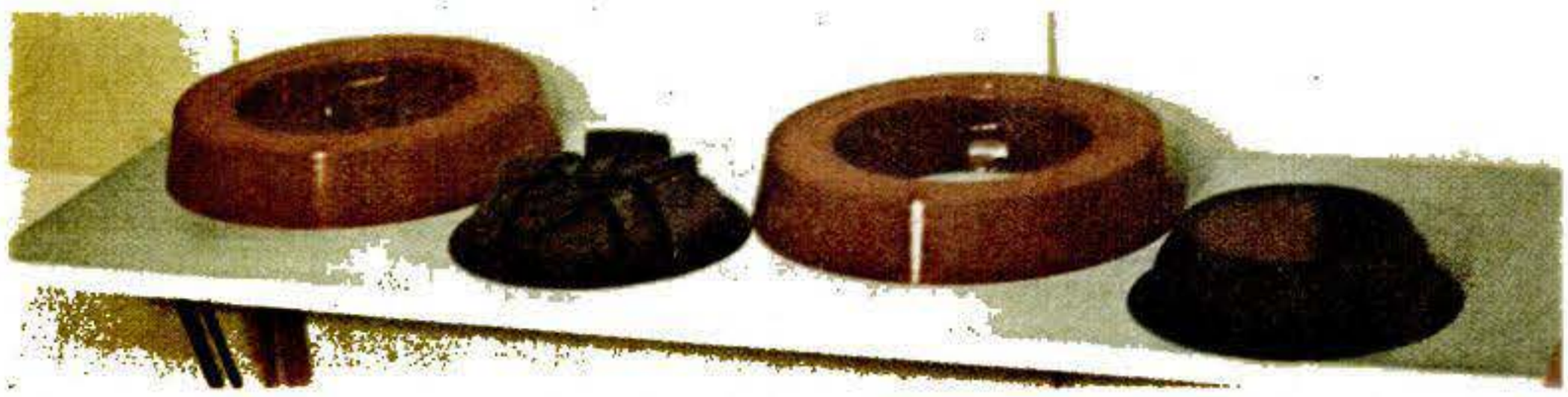
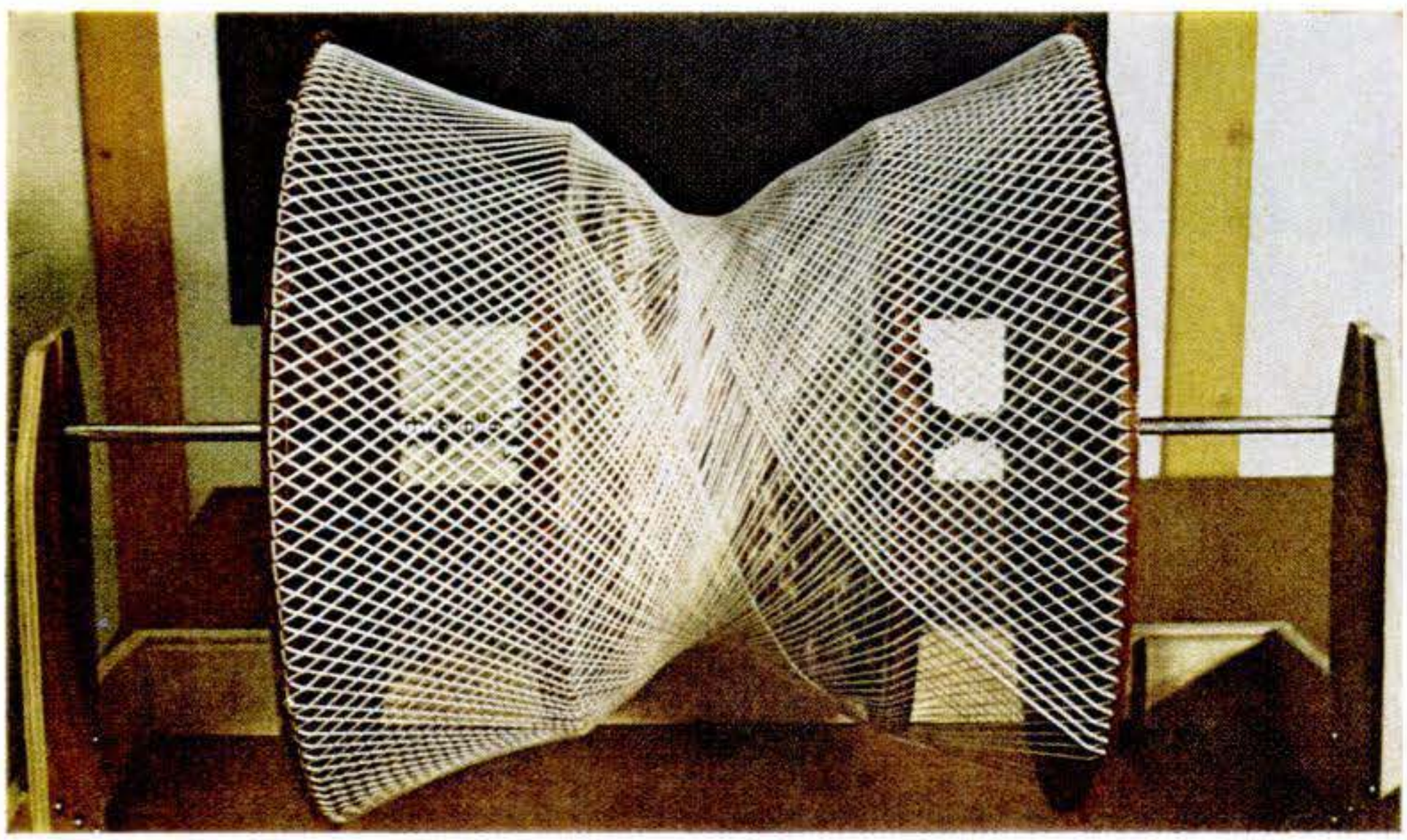
Positive patterns are carved from wood, representing end product. From these, the molds (seen below) can be formed. Molds are negative, i.e. external.



The Gageby plastic wheel can be manufactured in any color, or fabricated in a transparent state, showing the internal structure of glass and nylon filaments.

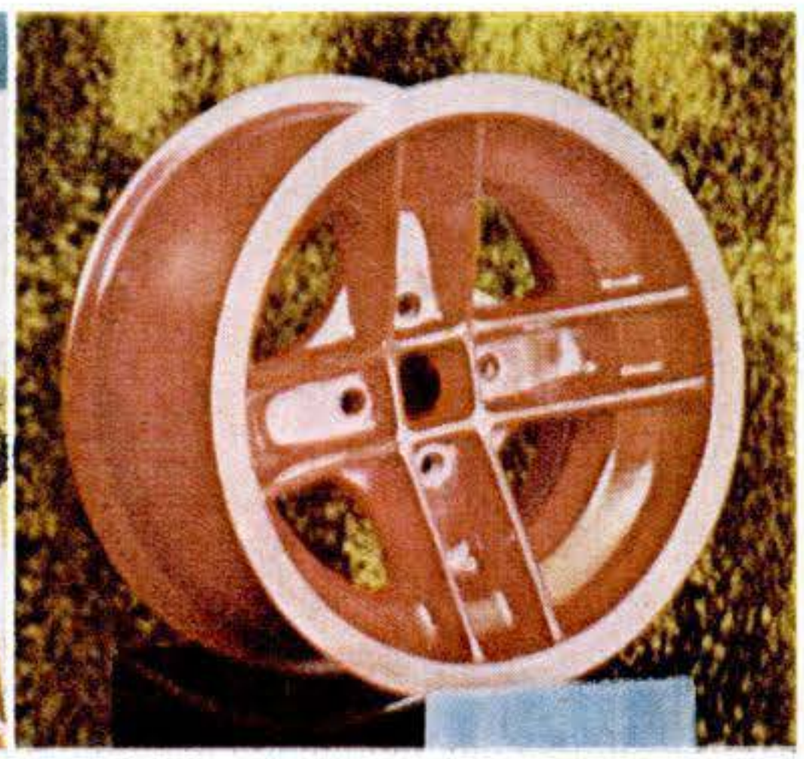


Negative molds are made in two pieces that close like a shell around the plastic material (synthetic resin) poured over the filament base that's in middle.



After one rim-winding sequence, the filaments are wound in place over the molds. Winding patterns can be altered to suit the wheel type and application.

Diagonally woven sheath tube is wound in place over mold system, while bead area is reinforced with circumferential bands of one-way-woven filaments.



When wheel comes out of the mold, lug-bolt holes are drilled and flanges are machined using machine shop techniques for resins—polyester or epoxy.

Plastic Auto Wheel ...Stronger Than Steel

Extremely light weight, fire resistance, and enormous strength are its advantages

By JAN P. NORBYE
PS Automotive Editor

How can plastic be made hard enough to use in wheels? The secret is in the inner reinforcement. The wheel is built up from the hub by an intricate webbing of fiberglass and nylon filaments. Dr. Steven Gageby of St. Paul, Minn., has developed this to a fine art, and his plastic wheel, which has half the weight of a magnesium wheel of the same size, also has eight times the tensile strength of magnesium.

It is 10 times stronger in bending, and Dr. Gageby claims a nearly infinite fatigue life for his wheel. Its Rockwell hardness is twice that of magnesium. Magnesium has a big drawback: It will ignite and burn in a fire following a collision. Plastic wheels can be made of self-extinguishing, flame-retardant resins.

Lightness is of utmost importance, since wheels are unsprung weight. Lower unsprung weight results in better ride and handling qualities. That's the stuff that wins races, and racing cars probably will be the test vehicles for the plastic wheel.

Michelin in France has been experimenting with plastic wheels for years, and a Citroën SM won the 1971 Morocco rally wearing them. Plastic wheels for production cars are probably still a few years away—mainly because of high cost.

Car stylists will love the plastic wheel for the scope it offers in color and design, and once the auto industry decides it wants something, it has ways to cut costs quickly.

Ultimately, the plastic wheel will probably be combined with new-concept tires, such as the Firestone cordless tire. About 1990, wheels may be a one-piece casting, and tires another one-piece casting. After the year 2000, perhaps we'll get a one-piece tire/wheel. PS

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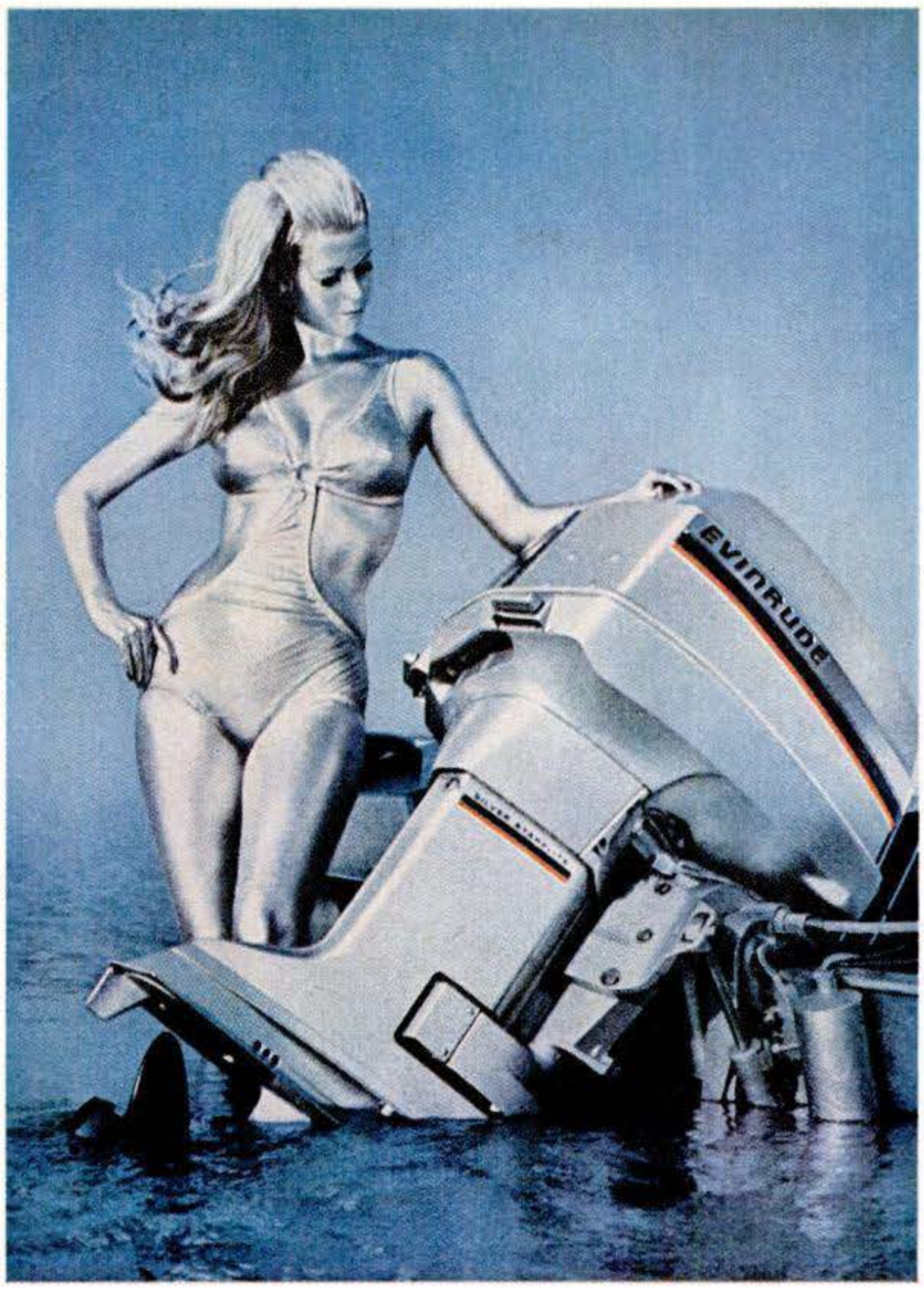

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The exciting new world of boating escape power.

They're on the way to your dealer's now — 22 escape-inspired ways to get away. From 70 mph powerhouse V-4's to a tiny electric trolling motor.

New super sophisticated "135" — A distinctively styled, limited edition satin-silver V-4 — with performance and luxury features no outboard at any price ever had before.

New loop-charged "70" — Swift. Sleek. Strong. Loop-charged and pulse-tuned for performance and economy; power-geared for torque and thrust.

New electric start "15" — All the features a fisherman could want; now, for the first time, in a motor he can carry. Electric and manual start.

New low-profile 9.9 — Even smaller than our classic low-profile 9½, and with all its great features plus exciting new ones. Electric and manual start.

New Sport Evinrudes—Now Evinrude performance motors come in Evinrude racing colors — with a bold new race "look" straight from the championship racing circuit.

Write for our escape literature, beautiful mood paintings, and complete specs on all 22 models. Evinrude Motors, P.O. Box 663, Milwaukee, Wisconsin 53201

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DIVISION OF OUTBOARD MARINE CORP.
first in outboards

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NEWEST MID-SIZE FOR 1974

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With sweeping, clean lines. Low profile. And plenty of window area for all-around vision. Test drive the new Matador. And see why experts are already calling it America's sportiest new car.

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A GUARANTEE YOU CAN UNDERSTAND.

When you buy a new 1974 car from an American Motors dealer, American Motors Corporation guarantees to you that, except for tires, it will pay for the repair or replacement of any part it supplies that is defective in material or workmanship. This guarantee is good for 12 months from the date the car is first used or 12,000 miles, whichever comes first. All we require is that the car be properly maintained and cared for under normal use and service in the fifty United States or Canada, and that guaranteed repairs or replacement be made by an American Motors dealer.

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And that's why we back our cars with this simple, strong guarantee. A guarantee that covers every part—except tires—even those annoying little things that occasionally wear out like spark plugs, wiper blades and light bulbs.

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Science Newsfront

Last-minute news and notes to keep you up to date By ARTHUR FISHER

Target Mars: Will Viking find life here?

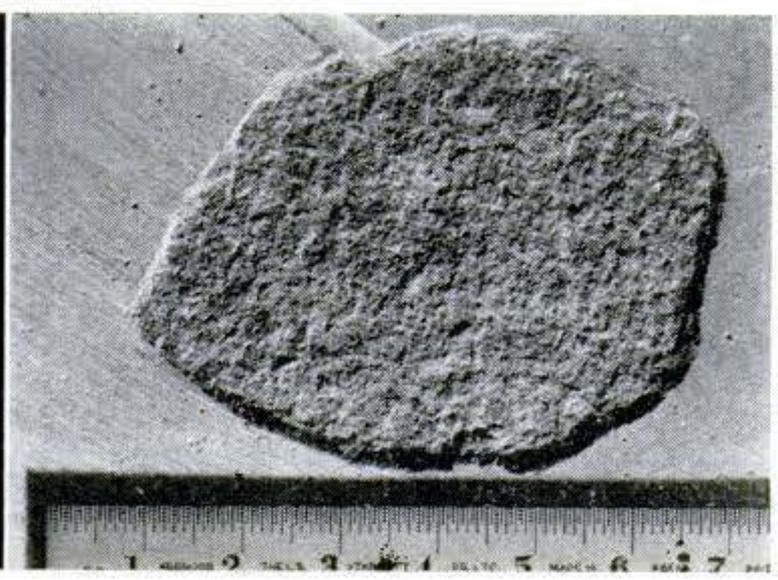
When our unmanned Viking lander parachutes to the Martian surface on July 4, 1976, it will settle at the mouth of the large, serpentine channel you see in this Mariner 9 photo. The site, in a region called Chryse, is being studied by the U.S. Geological Survey. Harold Masursky of the USGS points out that the "search for life is the important factor that has guided the choice of landing sites." Chryse was picked because it looks like a place where water once flowed. A second Viking will land later where water might exist now.

Tunneling with electrons

Some of the most promising concepts for future high-speed transportation systems call for 300-mph trains running through underground tunnels hundreds of miles long. But with present excavation techniques, such tunnels would take formidable amounts of money and time to dig.

Now there is the hope of some day using machine-gun-like bursts of electrons sprayed from a "ray gun" to do the job. The gun would be a very powerful version of a particle accelerator fitted with a special nozzle. The idea is being tested at the AEC's Lawrence Berkeley and Livermore Laboratories (California), and the photos here are proof that the concept is workable. The one on the left, an ultra-high-speed photo, shows pieces of rock being exploded away from a 0.4-inch-thick slab of granite after being bombarded with a single intense burst of electrons for only one 20 millionth of a second. The burst entered on the right and not only disintegrated rock there but created a pressure wave that fractured the left side as well. The right-hand photo shows the hole made in hard basalt by a single burst of electrons.

In practice, an accelerator fired hundreds of times a second would spray a beam of high-energy electrons back and forth, like a fire hose, rapidly pulverizing large sections of rock. Rock dust and debris would be vacuumed out of the tunnel.



Polywater evaporates

Polywater fans, the bubble has burst. One of the most enticing speculations of modern chemistry has ended with the conclusion of Dr. Boris V. Deryagin—the man who launched it all—that he was wrong.

The Soviet physicist started the controversy by declaring in the sixties that he and his colleagues at the Institute of Physical Chemistry of the U.S.S.R. Academy of Sciences had created a brand-new form of water [PS, Dec. '69] with dramatically different physical and chemical properties from the normal stuff.

For example, samples the Russians prepared were denser than water, as gooey as Vaseline, and had different boiling and freezing points.

Analyses made by scientists in other countries seemed to show that polywater (also called "anomalous water" and "water II") had a molecular structure utterly unlike normal water, similar to that of complex organic chemicals called polymers.

But other scientists claimed *their* experiments showed that so-called polywater was really water with silicon dissolved in it—the silicon coming from the quartz capillary tubes in which the stuff was condensed. (Quartz is a form of silica—silicon dioxide.)

The enormous difficulty in producing even minute quantities of the legendary substance—probably no more than a thimbleful has been made altogether—did not help to resolve the question.

Now Deryagin himself has cited recent Soviet studies that detected the presence of silicon atoms in samples of the controversial substance, even under most pristine laboratory conditions. In other words, the critics were right all along. The key to the mystery: When water vapor condenses in contact with quartz it can dissolve silicon far more powerfully than liquid water can.

"These experiments," Dr. Deryagin says, "do not support the

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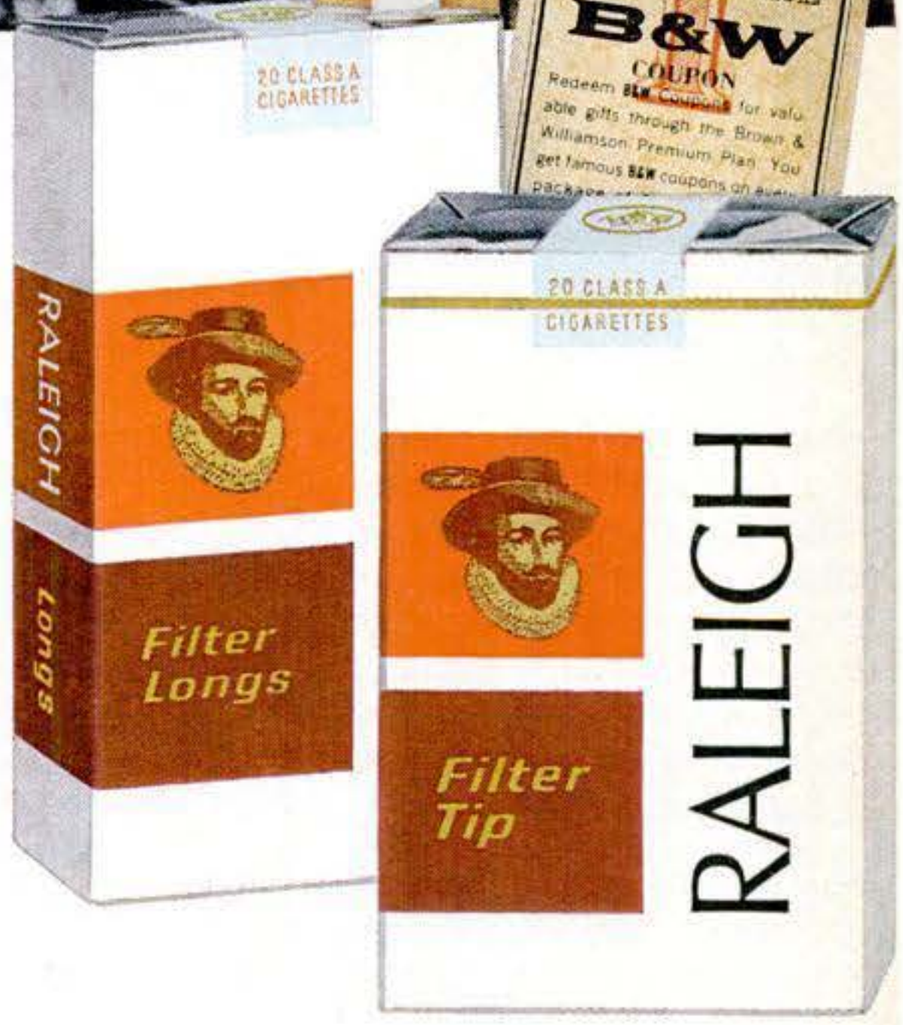

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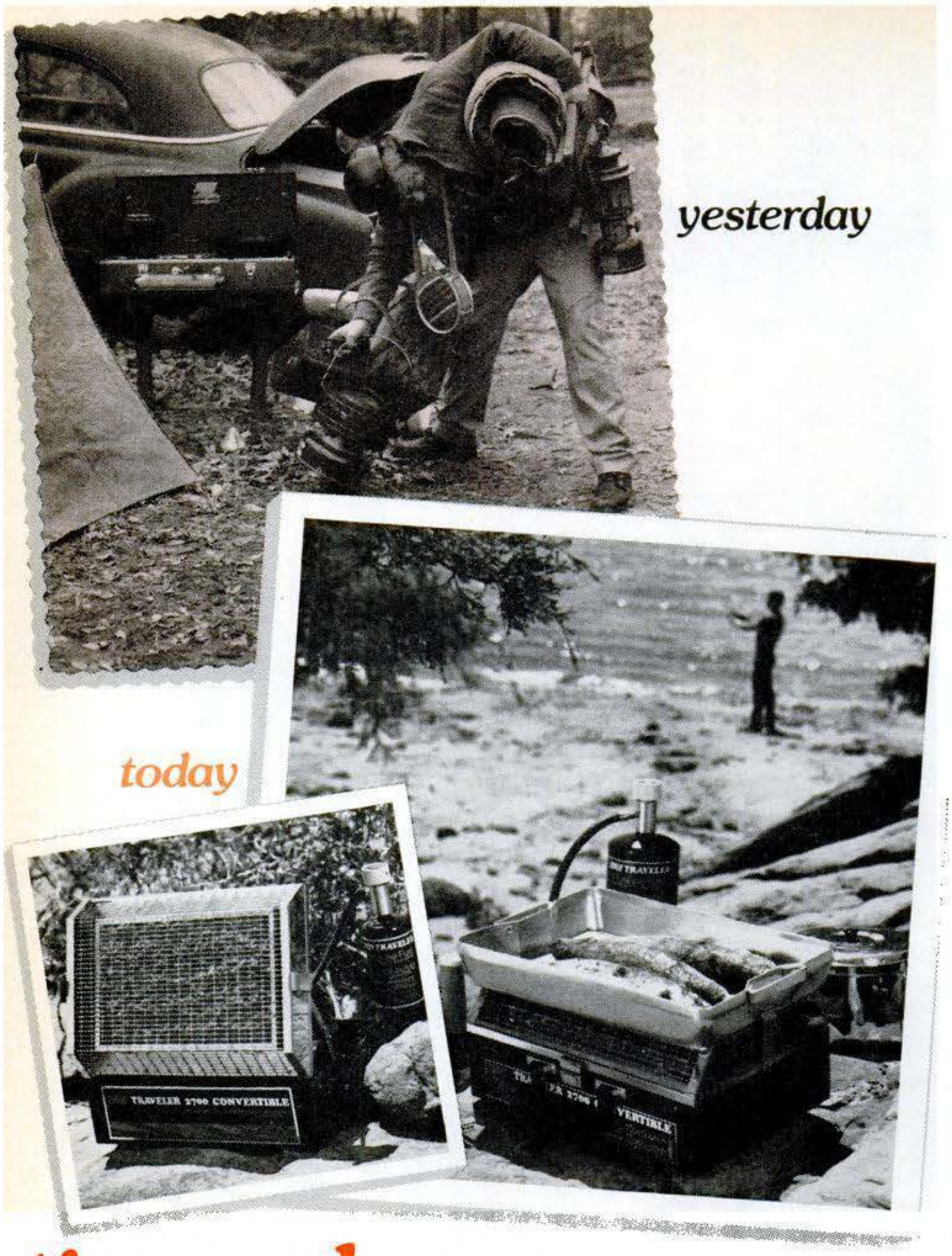

times change

In the era of gasoline-fueled camping appliances, there was no such thing as a multi-purpose unit. A stove was for cooking, a heater for heating, and the outdoorsman who took camping seriously took along everything but the kitchen sink.

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Science Newsfront

[*Continued*]

hypothesis of anomalous or polymeric water."

What the doctor's expression was as he said it was not reported.

Triumph of the century

Researchers at the Department of Agriculture are on the threshold of developing a new breed of bean with a fundamentally different chemistry that will guarantee that it cannot cause flatulence.

Mini-jet for air launch

This model with the strange shape represents a far-out bird the Air Force is hatching at its Arnold En-

gineering Development Center. It is a miniature jet fighter that could be air-launched from a large transport of the C-5 or 747 class, and—astonishingly—recovered in mid-air. The model has completed wind tunnel tests.

Oil on troublesome waters

Scientific efforts to prevent hurricanes have focused on seeding with chemicals to dissipate the killer storms. Some weather-modification experts think this approach not only inefficient but downright dangerous; it might alter weather patterns with unforeseen results.

Now experts at the National Oceanic and Atmospheric Administration believe they can nip hurricanes before they form by a totally different method. Working at NOAA's Miami-based National Hurricane Research Laboratory, William D. Mallinger and Thomas P. Mickelson experimented with biodegradable chemicals spread in a film just one molecule thick over a patch of ocean. Purpose: to impede evaporation of water to the air. Hurricanes are powered, in part, by heat energy transferred via evaporation. Chemical monolayers have been used in the past to slow the evaporation of water in reservoirs. PS

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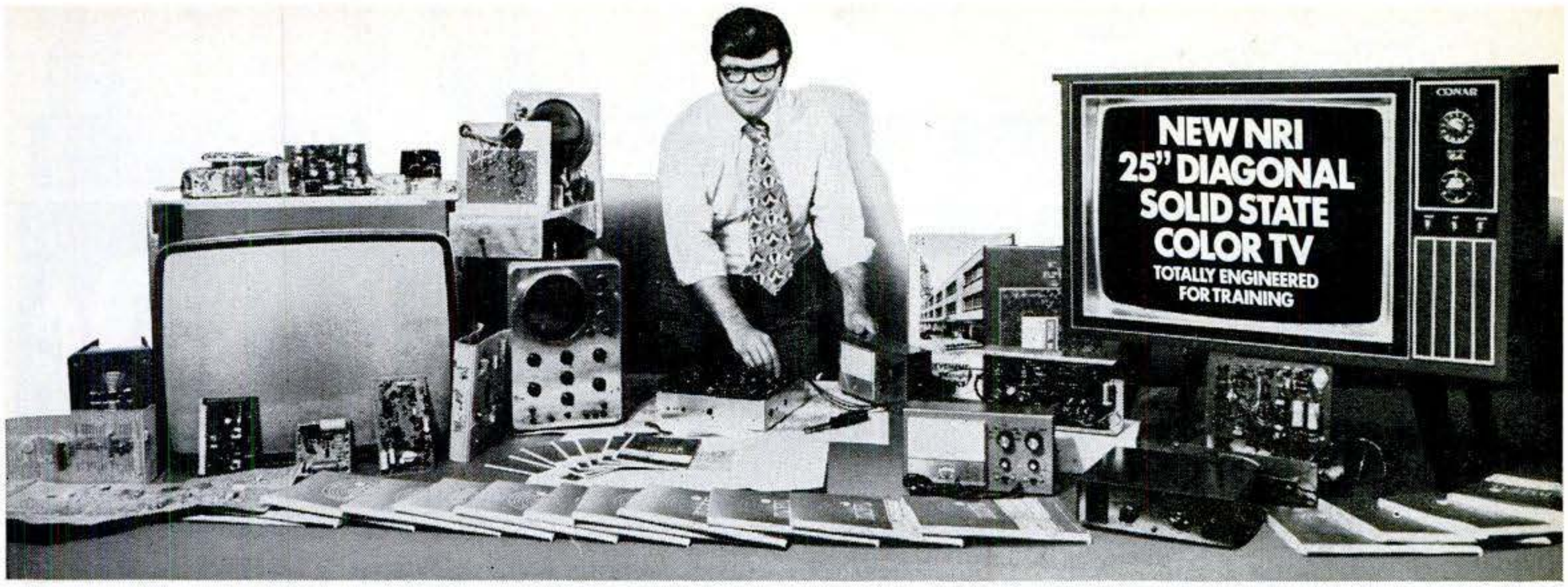

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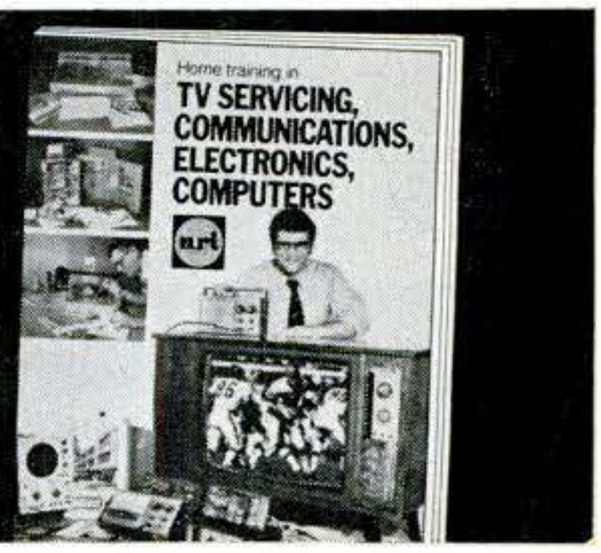

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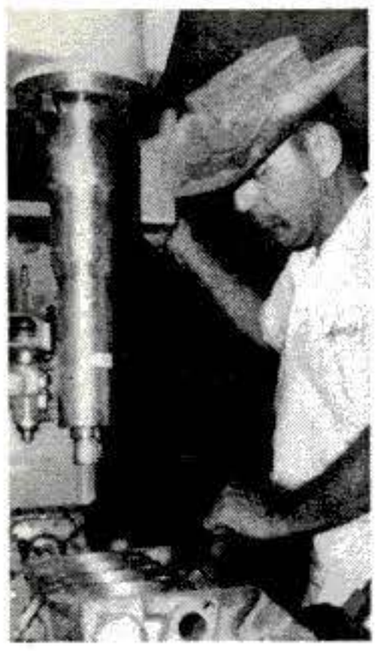

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A clinic on cars by America's most famous mechanic

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Switch to electronic ignition?

I think the new Chrysler electronic ignitions are a great idea. Unfortunately, my 1971 Plymouth Fury has the old conventional distributor and ignition system. I am thinking about putting in an electronic system, but I would like to know if you think it would be worth the trouble to replace the distributor with the new "no points" Chrysler distributor. Also, will the new distributors fit a '71 318, and how hard will the change be to make?

ROBERT SUTTON, Muncie, Ind.

I think you can do it without too much trouble, and I would use the Chrysler system for your car. But unless you intend to keep the Plymouth for quite a while, I wonder if you'll recover your investment? You'll get lower maintenance costs and better starting, but you'll gain no mileage.

Radial alignment problem

I have a 1970 Ford Country Squire with all power options and heavy-duty suspension. I have installed Mobil radial tires, and my problem is front-end alignment and keeping the tires balanced. Should I forget using the radial tires with the suspension I have? What do you suggest?

R. JOHNSON, Collegeville, Pa.

Try tire trueing and rebalancing. With everything else okay, that should work. Without knocking your tires let me say that different brands of radial tires produce different results on different cars. Remember that the radial tire is just coming out of the growing-pains stage. I think radials are worth the problems, and I'd advise you to try some more before you give up.

Front- versus rear-wheel drive

What are the advantages and disadvantages of front-wheel drive as used in many foreign cars over the standard rear-wheel drive in most American cars?

BILL RANDLE, Beaverton, Ore.

As I see it there is no advantage or disadvantage across the board. In certain cases front-wheel drive is a plus—for example, during ice and rain. Braking is at some disadvantage though, and maintenance is higher. Also, I am prejudiced; I think Americans should drive American cars.

Crankcase fumes

I have a 1964 Nova station wagon 283 with a strange problem. It has a strong odor smelling like crankcase fumes. With all the windows rolled up and the tailgate closed, there is no odor, but with any of them open, particularly right after I use a lot of reserve power, the odor is strong. I have put on new rocker-arm cover gaskets, oil-pan gasket, clean breather cap, and a new PCV valve. I'm positive the odor isn't coming from the exhaust; the exhaust line is new and tight. Any ideas?

DAVID JOHNSON, McClean, Va.

That odor is crankcase fumes, and with everything shut you can't smell it. But of course it's still there. So you have a dirty engine with leaking rings and probably leaking valve seals. If you want it fixed, the engine must be removed, cleaned, and parts replaced as necessary. Then maybe it will go eight or nine more years. There is no other way.

Stalling engine

My '67 Mustang 289 has A/C, automatic transmission, and a '70-model Ford two-barrel carburetor. The car will stall out when throttle is applied at about 15 mph with the engine cold, or just during hard right and left turns when the engine warms up. We have replaced the fuel economizer valve, fuel filter, and had the floats adjusted and idle speed set. The fuel jets were changed from 48 to 50, then to 52. New plugs and points were installed and the dwell and timing are set, but the problem persists. Suggestions?

KIRK HABIB, Fresno, Calif.

Stalling on acceleration is caused 99 out of 100 times by not enough accelerator-pump shot, or simply by an accelerator system that's too lean. Cutting out on a left or right turn indicates low float level. This will breed a lean accelerator-pump shot. Putting in richer jets will not help. You should get back to the factory recommendations. Late timing will aggravate a lean condition, so check that by the numbers.

Sways at any speed

My 1970 Chevy Kingswood Estate wagon sways at all highway speeds. I bought it used (two years old) with new shocks and installed all new tires. Put on coil booster springs over rear shocks with no effect. Tire pressure specs call for 36 pounds in the rear tires. This rides very hard and weaves on the center beads. Can you tell me what makes the car sway? It doesn't roll or pitch, but simply slips left and right. It has power steering and oversteers greatly. Is there a cure?

FREDERICK HOP, Stanton, Mich.

Looks like you're going to have to go deeper than into a service manual. I believe your trouble is lack of enough front springs and not enough sway bar; also, tires that are too stiff in sidewall construction. I'm basing this on your statement that it oversteers badly. In other words, there's not enough front spring relative to the rear, so the rear tires get overworked and can't handle it. Go to a Chevy dealer and get the heaviest front sway bar you can get, also the heaviest front springs. Then get a set of radial tires, such as Goodrich. With these changes and the car sitting still, push against the front and rear of the body or fenders. If you find any great amount of lateral movement at either end you will have to stop it with parts replacement—whatever shows up loose. Your problem sounds like roll-steer, and the things I am trying to get you to do will cut out a lot of roll.

Radio static

After a complete tune-up on my '66 Dodge Monaco, I started getting static from the ignition on the radio. I did change plug wires to Whitaker copper with resistors. Could this be the problem?

ALAN CAVIN, Irving, Tex.

I'd say you have answered your own question. But why not go to a car radio shop and have him slip his gadget on it? You'll know for sure in five minutes.

Sick synchromesh

I have a 1972 Vega with manual transmission allegedly synchronized in all forward speeds. And so it was, until about 8400 miles. Then it started to balk going into first gear, only from a standing start. It will go into first coming out of reverse with the clutch pedal depressed, and it will go into first when I'm starting the engine, holding the clutch pedal depressed. But it won't go into first normally. The dealer says this is normal, but after several letters to

Continued

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NO NONSENSE

SOME IDEAS FROM AC THAT MIGHT HELP IMPROVE YOUR GASOLINE MILEAGE

Spark Plug Misfiring Chart

Gasoline Mileage Loss (Test Results in Percentage When Spark Plugs Fail to Fire)		
Speed (m.p.h.)*	One Spark Plug Missing	Two Spark Plugs Missing
30	10.3% (loss)	34.6% (loss)
40	15.2% (loss)	36.7% (loss)

*Test conducted under simulated road load conditions on dynamometer stand

Yes, our spark plug engineers at AC have a number of "No Nonsense" ideas that may help improve your gasoline mileage.

1. It makes sense that generally you get better gasoline mileage if you drive at moderate speeds. Needless acceleration and jackrabbit starts can reduce mileage, too.
2. It makes sense to make sure your car is properly tuned according to factory specifications.
3. Whether you tune your car or have it tuned, we would like to recommend AC Fire-Ring Spark Plugs.

AC Spark Plugs are available most everywhere quality automotive parts are sold, so you'll have no trouble finding a set. And there's a set of ACs engineered to meet your car needs and driving conditions.

We believe our spark plug engineers' "no nonsense" ideas make a lot of sense. They're the experts who collected this test data to show the importance of spark plug performance and what can happen, should your spark plugs begin misfiring.

AC SPARK PLUG DIVISION

AC . . . for quick starts and a smooth-running engine

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The Winchester Model 70 brings you real cut checkering, machined chrome steel, redesigned stocks and finishes; and superb accuracy at a price you'll want to pay.

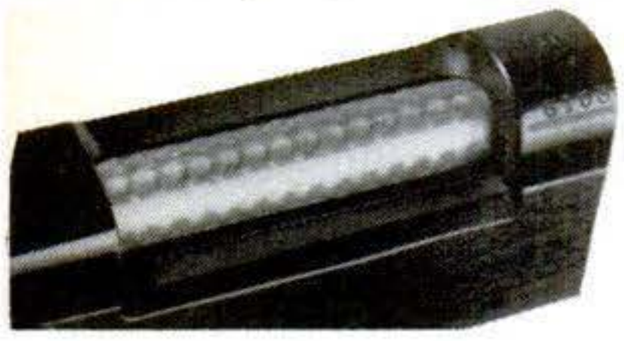
Make your next big game rifle one that will give a lifetime of shooting pleasure and showing pride. It's not for nothing that the Model 70 is known as "The Rifleman's Rifle."

The new Model 70.

Once you make a rifle as good as the Model 70 Winchester we turned out before 1964, it's tough to come up with an encore. But because we listened to your requirements very carefully, we're now making a new Model 70 that'll take the measure of any center fire rifle made today in the U.S.A. Take a look at these facts:

Machined steel receiver: The receiver on the Model 70 is precision forged from a single piece of chrome molybdenum steel specially formulated to Winchester specifications. Forging gives a better grain structure for added strength and safety. The receiver is heat-treated for durability and machined to close tolerances for smooth bolt operation. Integral recoil lugs give better security, and a flat bottom beds better in the stock for accuracy. The receiver is drilled and tapped for scope mount and micrometer rear sight. Receiver and barrel are assembled, then hand polished together. The result is exactly what you expect from Winchester.

Engine turned bolt: Machined from select chrome molybdenum steel, the Model 70 bolt features two oversize locking lugs for great strength. The bolt has a fully recessed bolt face for 50% better head support. An exclusive, slotted anti-bind bolt device below one of the locking lugs ensures flawless loading and ejection. Gas vent and steel gas cap are standard for safety. The bolt body is engine turned for a sparkling appearance. The Model 70 bolt is stronger, smoother, better looking, and simpler than the one we made before 1964 . . . and that means more accuracy.



Redesigned stock contour and real cut checkering: The Model 70 is a rifle that means business to the practiced eye and hand. The forend is slimmer, with a flatter bottom that fits the hand exactly. The pistol grip is elongated, and slimmed down. From black forend tip to Monte Carlo cheekpiece, you get a lean, clean look. The dark wood tones of solid American walnut tell a story of pure quality. As a final touch, there's real, cut checkering on forend and pistol grip. Get your hands on the new Model 70. It's for real.

Winchester Proof Steel barrel: This is the Model 70 story all by itself. Winchester pioneered the manufacture of rifle barrels through an automatic cold-forging process in order to make the most durable, accurate barrels available. Model 70 barrels are forged on super-precise machines that hammer cold chrome molybdenum steel blanks under 200 tons of pressure into superbly uniform rifle barrels. Rifling and bore, are forged into shape, not cut or machined. The result is extreme barrel strength, exactly concentric bores, and finished Model 70s that shoot groups as tight as you can hold.

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Three position safety: This feature is another Model 70 exclusive. Position #1, fully to the rear, and both bolt and trigger are locked. Position #2, with safety lever centered, and the trigger is inoperable, while the bolt may be opened to check the chamber, to reload, or to empty the magazine. Position #3, lever fully forward, and you're ready to fire. An extra safety feature is a red cocking indicator under the bolt cap which tells at a glance whether or not your Model 70 is ready to fire.

Knurled bolt handle: The polished, steel bolt handle on the Model 70 offers an extra bit of sure, confident operation. We've added knurling all around the bolt knob. Put yourself in the middle of some typical fall or winter weather when fast reloading for repeat shots could mean the ballgame, and you'll appreciate this small touch. And when it comes to precise touch, don't overlook the Model 70 trigger. It's wide, serrated, and has a clean release that means accuracy. Adjustable for over-travel and tension.

Hinged steel floor plate: There are times when a hunter wants to empty or reload his magazine in a hurry. With the Model 70, simply press the button in front of the trigger guard. The hinged, magazine floor plate swings free, and your unused ammunition drops right into your hand.

Wimbledon Cup accuracy: Only one rifle wins as often in target matches as in the field: The Winchester Model 70. A few excerpts from its trophy-proven record of accuracy: Won Wimbledon Cup 1000 Yard event more than all other rifles combined; 1968 Palma Matches: American team perfect from 800 yards, all with Model 70s; 1970 Phoenix World Shooting Championships: high individual, and 2 of top 3 teams used Model 70s; 1971 CISM Matches: 1-2-3 place winners all used Model 70s; 1972: The U.S. team, using Winchester Model 70s exclusively, took all first places, team and individual, at the CISM Matches in Cairo.

MADE IN U.S.A.

Detachable sling swivels: Most men who use a rifle rely on a sling or carrying strap to carry their rifle in and out of game country, or to steady their aim. Blued steel sling swivels are standard, as you'd expect from Winchester. These swivels also are quick-detachable. We don't call the Model 70 "The Rifleman's Rifle" for nothing.

Stainless steel magazine follower: The magazine follower in any rifle has little to do . . . except follow the ammunition, pressing it upward into contact with the bolt for feeding. Consequently, it's possible to make the follower out of many materials. If you buy a Winchester Model 70, we figure you're entitled to a rifle that's made right all the way, so you get a stainless steel follower on every 70 we make.

New Super Grade Model 70: We also make a top-of-the-line model for the man who will accept only the finest. Check the superlative quality features on our top-of-the-line Model 70 Super Grade: Fancy American walnut stock, with distinctive cut checkering, Monte Carlo, fluted comb, and cheek piece. Ebony pistol grip cap and forend tip, with white spacers. Non-slip rubber butt pad with white spacer. Steel hinged floor plate marked "Super Grade." Special matted finish on receiver bridge. Plus all the standard Model 70 features, including chrome molybdenum steel barrel and receiver.

New Model 70A: This one has the heart of the Model 70, with some trimmings left off. American walnut stock with real, cut checkering. Chrome molybdenum steel barrel and receiver. Sling swivels. Three position safety. Virtually every feature of the Model 70 . . . including performance . . . except the hinged floor plate and some other nonfunctional detailing. Many hunters actually will prefer the Model 70A's reserved, no-nonsense appearance . . . especially at its attractive price.

Model 70, Model 70 Super Grade, and Model 70A are available in popular calibers, including magnum models. All made in New Haven, Connecticut, U.S.A. See them now at your Winchester Dealer. ***WINCHESTER.*** 275 Winchester Avenue, New Haven, Connecticut 06504.

Model 70A Magnum

winchester
the way you
want it

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Customer Relations, they went into it. Now it is worse, and I am out of warranty. They put 140 "positraction oil" in it, but it still balks in first. What next?

W. J. GALLAGHER, Orlando, Fla.

Sounds like you have a bad synchromesh in low, and the linkage is a little off. This is assuming you're not exaggerating the problem. I have to add this last since I too am a dealer, and some of the complaints we hear drive us to the brink of insanity. But assuming you are right, then I would say pull it, adjust it, and replace parts as necessary.

Cooling it in stop and go

I own a 1972 Camaro with 350-c.i. engine, two-level carb, and Turbo Hydramatic. In any stop-and-go driving of even eight to 10 minutes the temperature gauge goes way into the red. I'm afraid to drive in the city because of it. It has done this ever since I got it. So far the dealer has replaced the thermostat, temperature gauge, sending unit, temperature switch; tightened the fan belt, and checked the coolant—all to little avail. Since this car gets 13-14 mpg and it's reasonably in tune, I intend to keep it until it falls apart. Is there any fix at all possible for it?

MICHAEL SCHOCK, Dayton, Ohio

Be sure you do not have a head-gasket problem and that your temperature-gauge sending unit is not affected by exhaust temperatures. Assuming those items are okay, then I believe the two biggest aids would be: 1) More fan action, that is, a bigger fan, more blades, or more rpm in reference to low-speed engine operation. 2) More radiator, for more square inches of cooling. Also, in your case, a direct-reading gauge as long as it stops under 190 or 195 degrees F. I don't believe you'll have any trouble or cause any damage. That light might be going on at 180 to 190 degrees and there's really no problem there.

Oil burner

I have a '70 Chrysler Newport 383 that at 60,000 miles uses oil like crazy. I had new neoprene valve-stem seals put in and a new PCV valve. There are no obvious leaks. Help! I'm running out of oil and dollars.

RUSSELL R. MOLITOR, Williamsburg, Mich.

If the oil is not going down the valve guides, not being burned for lack of proper crankcase ventilation, and not leaking, there is only one thing left—the most obvious. The piston rings are stuck or worn out. Some fuel pumps can leak and send oil to the intake manifold, but I doubt that's so in your car.

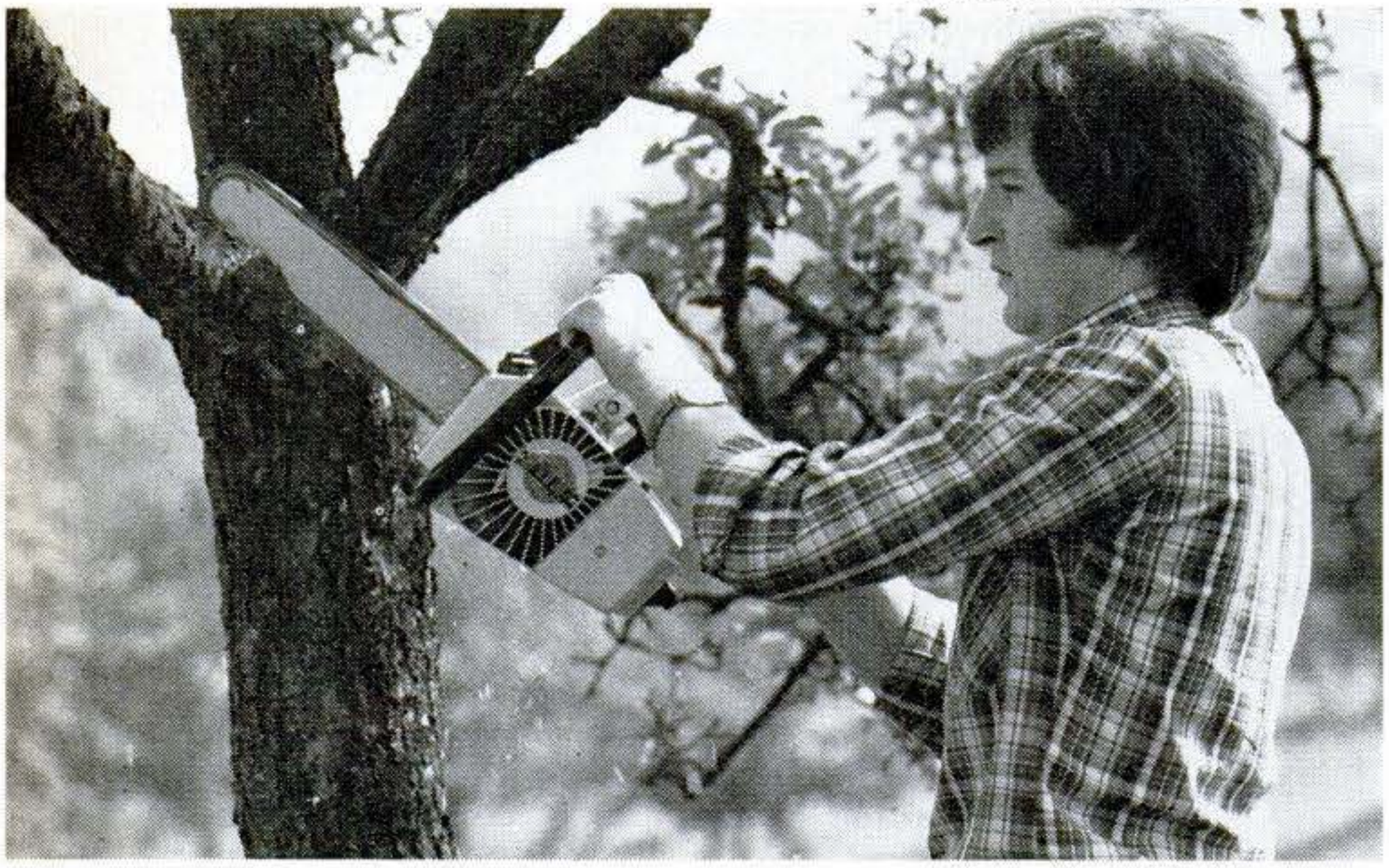
Hard-starting and stalling

In December 1972 I purchased a Plymouth Satellite wagon with the 400-c.i. V8. From the beginning I had difficulty starting the engine when cold: It would stall very rapidly once started and thereafter would hesitate when the pedal was depressed. This would last a while, and then with a puff of blue smoke the engine would pick up with no further problems until it was cold again. The dealer adjusted it several times, without success. Any suggestions?

MRS. WILLIAM EVERS, Fayetteville, N.Y.

Mrs. Evers, you will get out of trouble as soon as you find a dealer who has a good carburetor man. With the so-called emission controls, carbs are set very lean, and if they're off just a little, they are so lean the engine won't start—or it stalls frequently. It is not a guessing game, and the carb and ignition timing are tied in closely, so it must be adjusted very carefully. Some carburetors come on the lean side, and these can be difficult to adjust. Maybe the best thing would be to call Chrysler Service at the factory. PS

New from STIHL
World's First and Largest Chain Saw Manufacturer
STIHL 015
Automatic



Before you buy **any** chain saw – hurry down to your local STIHL dealer and see for yourself why this great new mini-saw offers you so much more for your money.

Here's a lightweight saw with extra value features that include:
a big **multi-baffled** muffler for extra quiet operation –
an automatic **gear-driven** bar & chain oiler that actually programs proper oil delivery –
a dependable precision-made **all-bearing** engine for longer life –
large, **metal** fan-cooled fuel & chain oil tanks (no plastic structural parts) and a modern, compact, lightweight design for easier & safer handling.

One demonstration will convince you...The STIHL 015 Automatic is truly
The Number One Value in a Mini-size Chain Saw!

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Why Ford's Wilfred Konzen became Subaru's Wilfred Konzen.

"One day, our neighbor drove home in a new Subaru. We tried it out, and a week later traded in our '71 Ford Torino for a Subaru Station Wagon. We liked it so much that we're now on our second Subaru."

"We put over 20,000 miles on our Subaru, much of it business driving. We keep records and figured out the cost of operation at 1-1/2¢ a mile, gas and everything else included. I like being able to travel top speed in any weather and still get 30 miles to the gallon or better. We get really bad winters out here, but the front wheel drive helps us get through them, even without snow tires. Subaru has lived up to every expectation."

Wilfred J. Konzen Jr., East Dubuque, Ill.

Every day more people are trading for a Front Drive Subaru

See your Yellow Pages for the dealer nearest you. Or call, toll free, 800-447-4700. In Illinois 800-322-4400.

Subaru automobiles priced from $2,459. Plus dealer prep., freight, state and local taxes,if any.
Subaru automobiles manufactured by Fuji Heavy Industries, Ltd., Tokyo, Japan. Imported by Subaru of America, Inc., Pennsauken, New Jersey.

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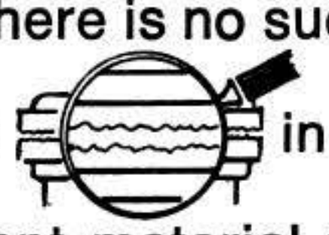
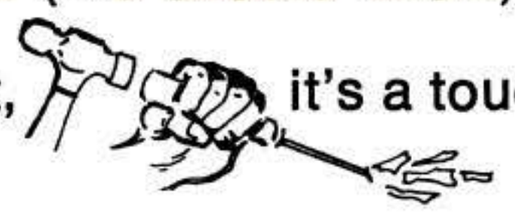
WHY GEL GASKET MAY MAKE GASKETS OBSOLETE.

Ever since the invention of the internal combustion engine, people have been looking for a better way of holding it together. The problem is simple: keep what is in the engine, in the engine; keep what is not, out. Through the years, solutions to this problem have ranged from oakum, paint, and a large variety of gaskets and sealants. Gel Gasket is the ultimate solution to this problem.

What is a gasket?

Theoretically, you don't need a gasket. If two surfaces were perfectly machined and put together, they would never leak. But there is no such thing as perfect machining. There are always gaps, scratches, unevenness  in machined parts. So the gasket was introduced. The idea was that a resilient material was squeezed between the two mating surfaces. It would fill in the gaps. And there would be no leaks.

What is wrong with gaskets?

Gaskets relax. They flex. They age. They have to be retorqued to keep them filling those microscopic irregularities. They have to be torqued carefully so that every part of the bearing surface has the same pressure. A sealant helps. (We should know, we sell eight million tubes a year.) And when it is time to take it apart,  it's a tough, time consuming job to get the old gasket material off.

How does Gel Gasket work?

Gel Gasket is a product of eight years of laboratory work. It has many remarkable properties. You squeeze it out of its tube in a thin (5/64) bead. It will stay in that gel form until energy is applied. This is in the form of bolting the parts together. It then flows into all the microscopic scratches and imperfections. Then it changes its form into an extremely tough, extremely strong solid. Unlike other types of products, it does **not** shrink. It does not release solvents. So if you start with an ounce of gel, you end up with an ounce of gel gasket. You bolt the part together once, and forget it. No need to retorque. No need to wait. You can use the part immediately. Yet when it comes time to disassemble, you can remove it easily. A finger nail will do.

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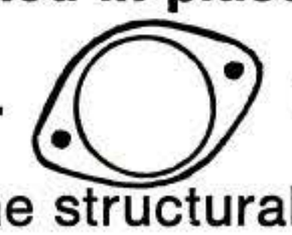
Why is Gel Gasket better?

Using Gel Gasket actually makes a stronger engine. What you have, in effect, is millions of tiny keyways holding things together. It won't leak. There is no place for anything to go. In a sense, it makes the parts perfectly machined. You never have to retighten anything. You put it on, bolt it together, drive away and forget it.

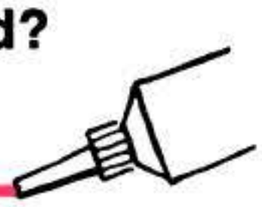
How is Gel Gasket different from formed-in-place gaskets?

A formed-in-place gasket is a gasket.  It has the drawbacks of a gasket. It flexes. It relaxes. It does not contribute to the structural integrity of the part.

Where can Gel Gasket be used?

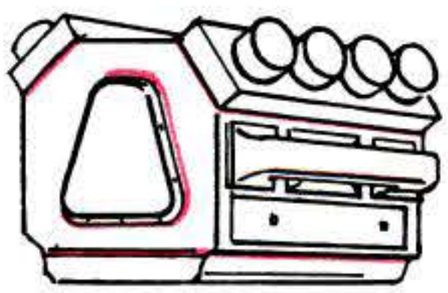
Anyplace you use a soft gasket or a paper gasket. The temperature range is from minus 40° to plus 350°F, so you can use it just about anywhere at any time.

How is Gel Gasket applied?

Cut the tip at the mark.  That will give you the right size bead. That size bead is correct for any application. A little goes a long way. Just squeeze out a continuous bead, making sure there are no gaps. Naturally, you go inside of bolt holes. Then just bolt the parts together to the recommended torque settings. That's all there is to it. The part may be used as soon as you can turn the switch.

Will Gel Gasket make gaskets obsolete?

We think so. We've tried it on race cars, motorcycles, marine engines, outboards, lawnmowers, and a motor home. Why don't you try it yourself, and see?



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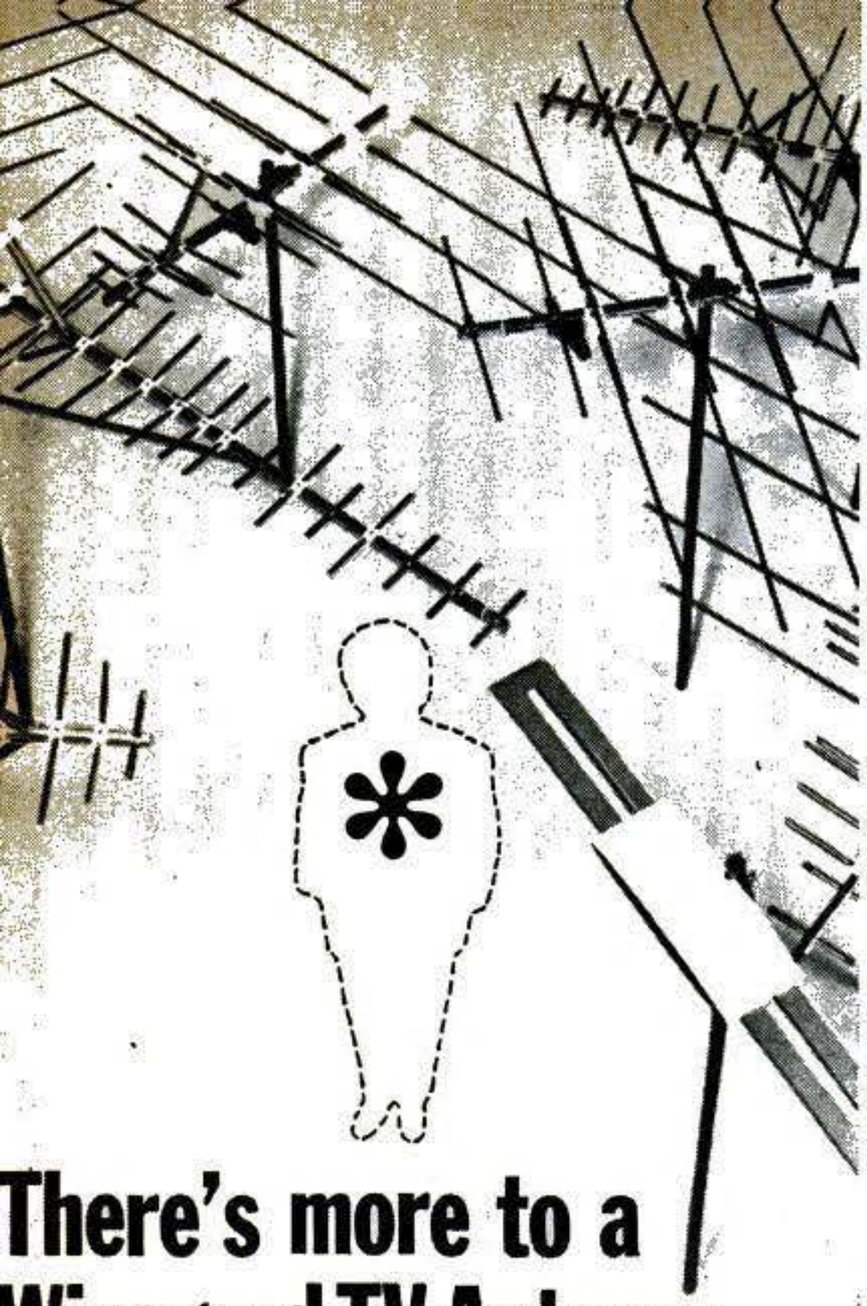

There's more to a Winegard TV Antenna than shows on the price tag!*

Much more! Like the sophisticated electronic design that only an engineer could really appreciate . . . but you can see the results right on your TV screen.

Winegard's only business is TV reception, and that pays off for you. Winegard holds many basic patents for color TV antennas, and has an electronics research laboratory in Denver working full time on advanced TV reception products.

And naturally, Winegard's "state-of-the-art" antennas are backed up with unsurpassed construction: high tensile strength, weather-protected aluminum elements . . . precision alignment . . . heavy duty brackets . . . every feature for longer service and better reception on all your TV channels in color and black and white; FM and stereo too!

Choose the antenna the experts and surveys recommend: Winegard . . . because there's more to it than shows on the price tag!

* "My name, for one thing! When you put up a Winegard antenna, I know you'll be satisfied. If not, write me personally and I'll make sure you get the best possible reception for your location. And that's a promise!"

John Winegard

WINEGARD COMPANY
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Send me FREE

☐ Facts on "Pay Cable TV and Winegard's CableMate TV Antenna."

☐ "What you should know about color TV reception . . . and color TV antennas."

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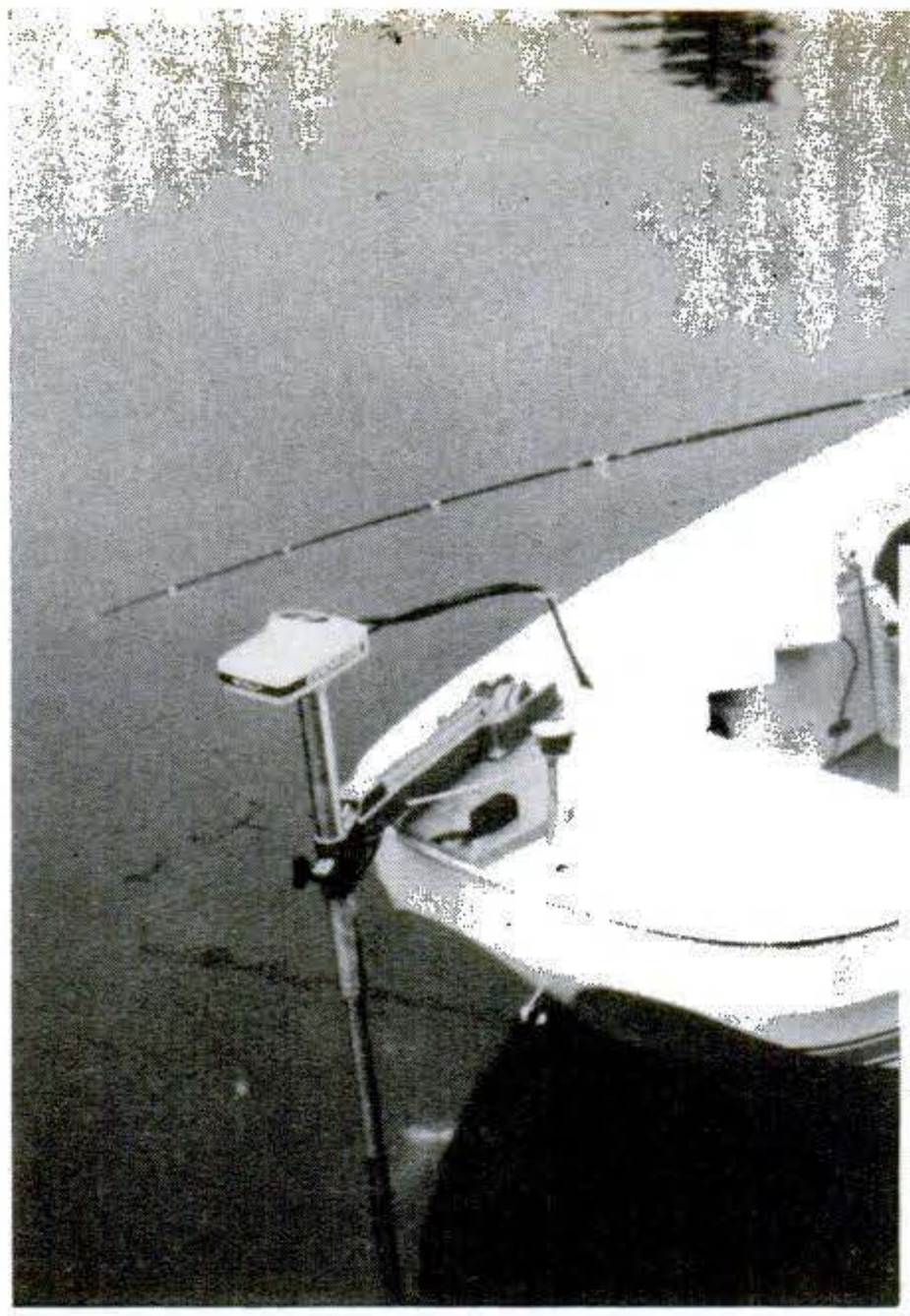


Electric Scout has a 10-degree-angled lower drive with Lexan prop. Foot pedal gives 360-degree steering via push-pull cable. The motor is designed for either bow or deck mounting.

PERSONAL-USE REPORT

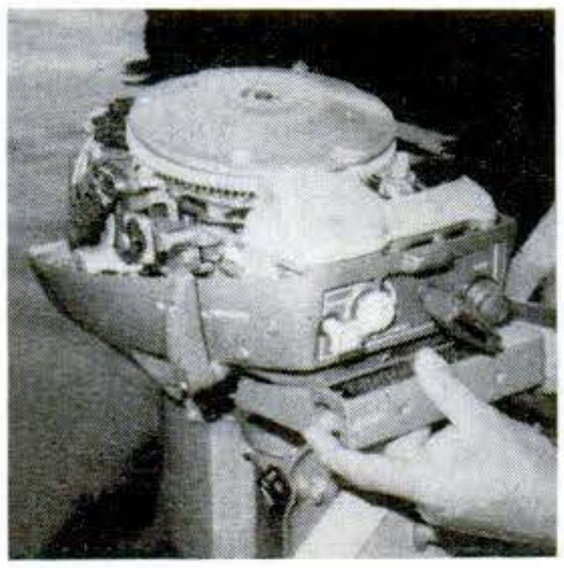
For Fishermen: A Little Electric, and Two to Get You Out There

Along with new 9.9- and 15-hp fun and fishing outboards for '74, Evinrude has a retractable electric that drops into the water like a Mixmaster into a bowl and lets you sneak around stumps and hold against wind and current in almost dead silence.

If you've used electric maneuvering motors before, you'll especially appreciate the Scout, with its angled motor drive and with the swivel tube at the leading end to aid slipping through weeds without hanging up the propeller. The direction indicator is also angled so you don't have to crane your neck.

To put the Scout into action, you just tug a lanyard, and the unit slides down over the bow. A reverse tug hauls it up. The Scout was a pleasure to steer because of the comfortable action of the foot plate, which rotates the power head through 360 degrees.

The Sportwin 9.9 and Fastwin 15 (with optional electric-start) are designed to get you out to where the fish are. I particularly liked the electric-start 15-hp Fastwin. You get not only the safety and convenience of electric starting, but also a five-amp generator for light and accessories. The motors—first cousins of the new Johnson fishing motors [PS, Aug.]—are narrower and shorter than '73 models, and have a new through-hub exhaust prop.—*E. F. Lindsley*



Starter button on 15-hp (left) is on handle. (Or you can use rope.) White knob is idle-mix control.

Twist grip and idle-speed control are set for low speed. Low-tension ignition coils are behind starter.

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Introducing the 1974 Impala.
The road to staying America's most popular car is a rough one.

For 13 straight years, Impala has been America's favorite car—the great American value. And for a number of good reasons. Some of which have to do with rooster tails, baking and freezing.

Rooster tails.

We make rooster tails by barreling through our own man-made floods. Water, as you know, can play havoc with the undercarriage and brakes. And salt water is worse.

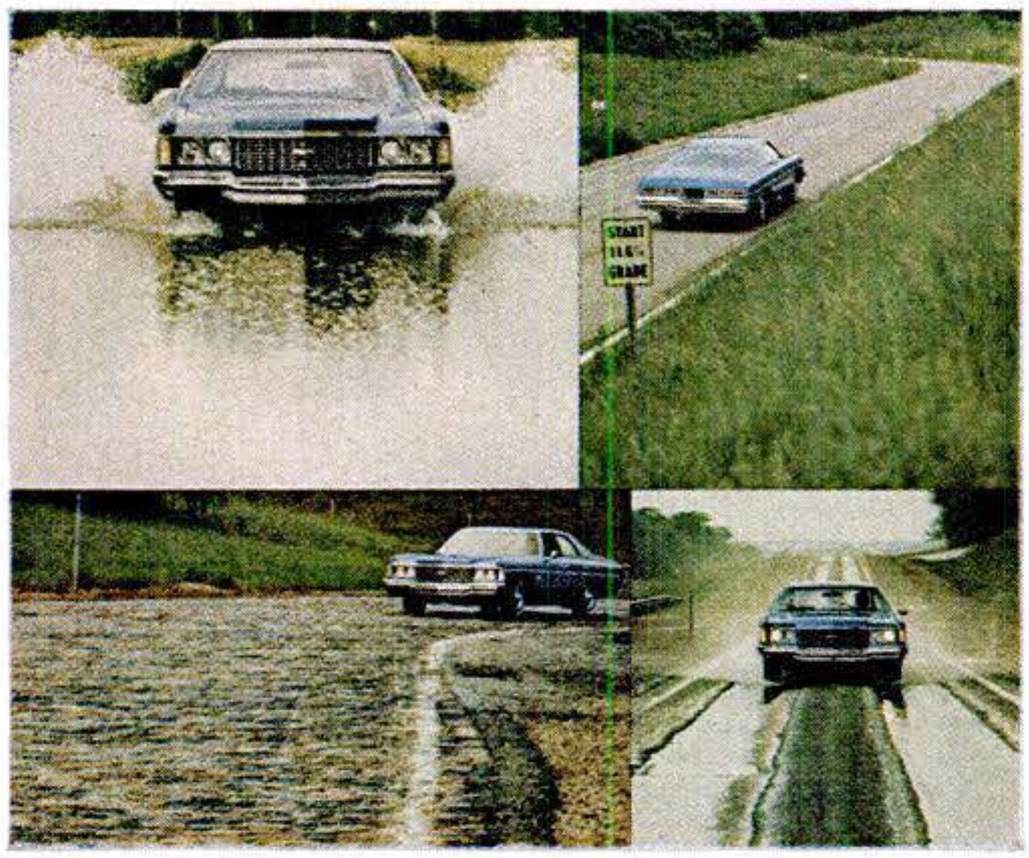
So for 1974, all Impalas have a new corrosion-resistant frame coating. And all come with power front disc brakes that resist the effects of water.

The disc brakes also have brand-new wear sensors. They sing out and warn you if the disc pads need replacement.

Impalas are driven in the middle of Arizona in the heat of summer, when metal gets so hot you can barely touch it. That's why Impala's acrylic lacquer finish is formulated to resist fading or dulling.

A car doesn't like extreme cold any better than it does intense heat.

So we also drive Impalas in the frigid climates.



We show no mercy.

We drive Impalas on virtually every kind of driving surface, including some we hope you never encounter, like "Belgian blocks."

And when you see and drive our new Impala we think you'll appreciate the fruits of its labors.

Just look at it. Exceedingly handsome styling. With a massive new grille, a new roof line that features a wide expanse of glass, plus the comforts that leave you with little else to do but enjoy the ride. Which, of course, is what owning a big car is all about.

Here's another point to ponder:

For years, Impala has not only been the nation's top seller, bar none, but it has traditionally brought a high resale value.

1974 Impala. The great American value. When you buy it. And when you sell it.

Chevrolet

Impala Custom Coupe

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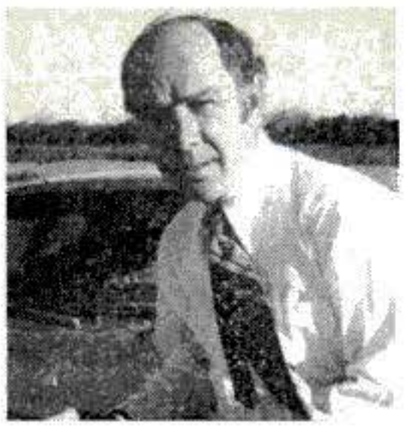

Detroit Report

Behind the scenes in the auto industry

By JIM DUNNE / *PS Detroit Editor*

New styling for Chevy's Wankel car

The Wankel-powered Chevy, due for its debut in August '74, will be Vega size, but it will not look like the Vega. Chevrolet is preparing a newly styled body for this car—a 2+2 coupe with a fastback roof line and a hatchback rear door. The car will use Vega chassis components. Chevy plans to price the Wankel car between the Vega GT and the Corvette, which means it could sell for $3500-plus. In designing the new body, the stylists were instructed to avoid the mistake of the trunkless Corvette. The Wankel car will provide extra storage space even if it means cutting down the dimensions of the fold-down rear seat. The back seat is intended only for occasional use.

Return to the 16-inch wheel

GM chassis engineers admit they are considering 16-inch wheels and tires for '75-model full-size station wagons. Government standards on brake performance (set for Sept. 1, 1975) indicate a need for bigger brakes, and brake engineers want extra space inside the wheels for them. Right now, GM is talking with the major tire companies about the possibility of supplying these tires in large numbers.

For about 30 years, 15-inch tires have been the biggest passenger car size. At the opposite end, some compacts went down to 13-inch wheels for a brief spell in the early '60s.

More minicars from Detroit

The swing to small cars has not reached its end. Maybe it's just begun. Both Ford and GM are now building prototype models that will sell below Pinto and Vega. Chrysler is making preparations for its own small car, sized like the present subcompacts. The new Ford and GM designs involve front-wheel drive and four-passenger capacity.

The "package" is seen as similar to the minicars built by Fiat (127), Renault (R-5, R-6), and others in Europe. These cars are about a foot shorter than Pinto and Vega and aimed at the lowest price segment in the U.S. market.

Neither project has the green light at this time, but once the go-ahead is given, each could be put in production within three years. Worldwide markets are ready for such cars, and that lends urgency to the projects.

Detroit puts its cars on a diet

Your next car will be lighter, despite the addition of more safety and emission-control equipment. Auto company officials are determined to cut down on fuel consumption, and the best route is to reduce the weight of the car itself. That's why you'll see more plastic and aluminum in bumpers and other body parts.

Olds is experimenting with an aluminum hood that saves 40 pounds compared with the steel hood on the '74s. And Chevrolet says that the aluminum bumpers on the '74 Camaro save almost 50 pounds compared with the steel bumpers on the '73 model. With potential savings even higher, the auto companies are willing to develop new techniques for manufacturing the lighter materials.

The benefits of plastic bumpers

Those body-colored bumpers that Chevy, Pontiac, and Ford have on some models will show up on more cars in the future—partly for styling reasons, partly because they do a better job. They cost more, too. It's no accident that plastic bumpers are used on high-line and sporty models (Grand Am, Laguna, Mustang, Corvette). Now Chrysler and American Motors have plastics programs too.

Plastics have three big benefits: The material is lighter in weight, blends in with the body panels, and returns to original shape after impact. High-speed forming machines that turn out plastic parts with machine-gun rapidity may take care of the cost problem.

Anybody wanna buy a big car?

Every month, fewer Americans buy big cars. Detroit product planners were shocked by the massive swing away from full-size cars this year. In May alone, the big cars dropped more than two percentage points of market share. Marketing experts now say that standard-size cars of the 1980s will be smaller than the current intermediates. They'll be roomier, too, built along the lines of the biggest European cars, like Mercedes and Peugeot.

Studies are already under way to see if people will accept an expensive sedan with seating for less than six. Preliminary returns indicate that Detroit four- and five-passenger models would lose no appeal.

Setback for truck-type turbines

Despite the progress in passenger car turbines by Chrysler, Williams Research, and EPA [PS, Sept. '73], the truck turbine engines suffered reversals at GM and Ford. The two big companies have half-promised turbine trucks "next year" for five or six years now. They finally got industrial and marine turbines into production, and the same units were to go in trucks. But they didn't.

Then last winter GM announced that its turbine program was being revised, and Detroit Diesel Allison is now working on an entirely new truck turbine design. In June Ford made a similar move, scrapped its advanced prototype program. The intended turbine could not deliver what the engineers aimed for. Both companies went back to the drawing boards.

Meanwhile, over in Japan, Nissan (Datsun) and Toyota have expanded their turbine activity, and in Europe, Fiat is working on a truck turbine, while VW is testing turbines for cars.

Spark plugs will last longer

With the new electronic ignition systems becoming available on more cars [see " '74 CARS: Electronic Ignition," this issue], the spark plug market could take a beating. GM cars equipped with high-energy ignition call for new plugs after 24,000 miles. Chrysler recommends 18,000-mile intervals. That contrasts with the 10,000-12,000 miles recommended by the spark plug companies.

GM's standardization of tires

Tire dealers are worried. Just when it looked like the proliferation of tire types was ready to stop, GM announced its steel-belted radial Spec. Tire. This will mean that all tire dealers who want to service GM cars should carry Spec. Tires in stock.

There's also some talk that Ford may come up with its own design since Ford's tire experts don't agree with the design goals of the GM tire experts. That would mean another new line of tires.

In addition, dealers must carry their regular lines—bias-ply, bias/belted, and low-price radials, in all sizes. It's also expected that super-premium tires will be offered to top off the selection. Then if the 16-inch tire returns, stock requirements will grow across the board. PS

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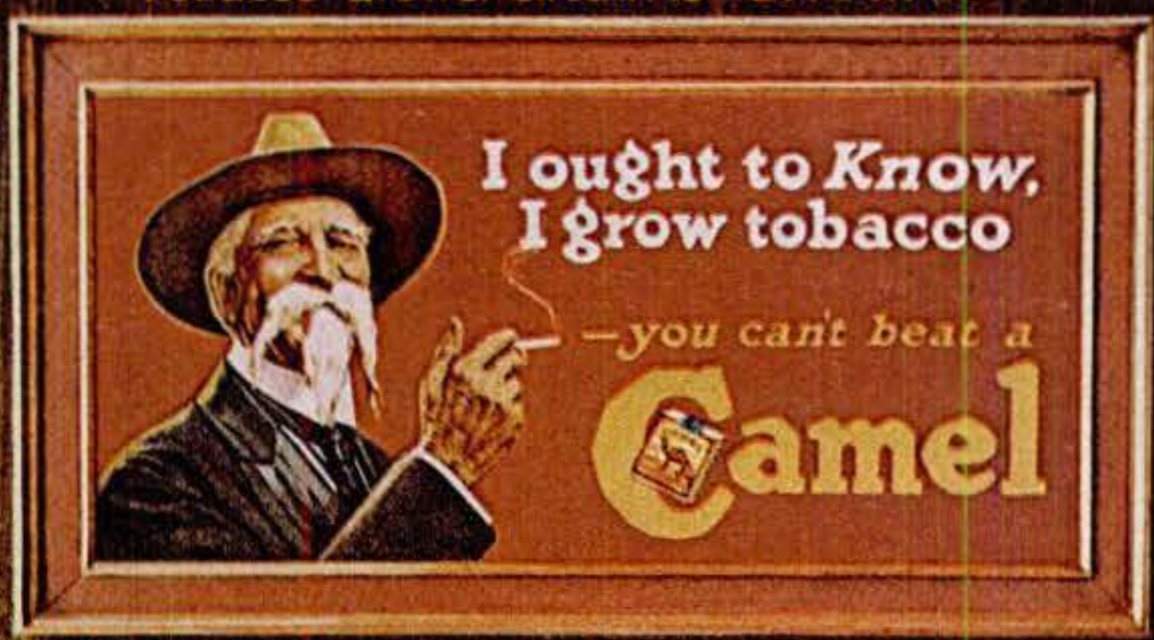
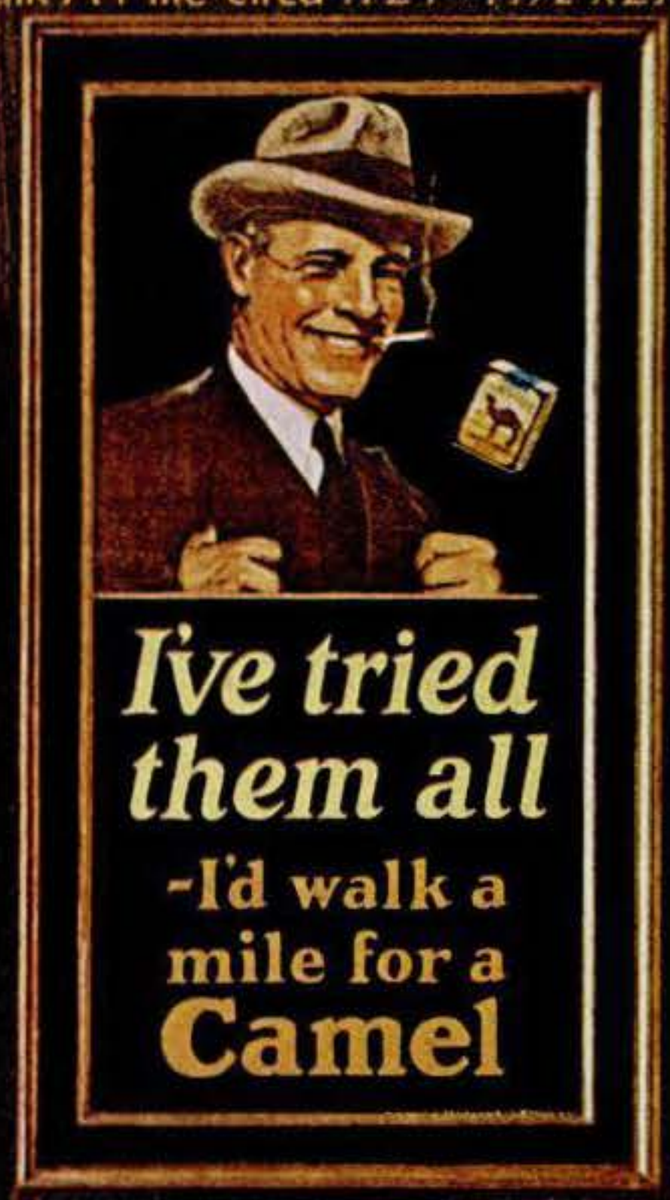
©1973 R. J. Reynolds Tobacco Co.

Tobacco Grower-circa 1915 • 27½" x 14½"



Clear Cut Merit-circa 1926 • 27½" x 14½"

Walk A Mile-circa 1924 • 14½" x 27½"



Big Nostalgia Hang-up! Authentic reproductions of 3 vintage Camel Ads.

(All 3 for One Dollar*)

For the 60th Anniversary of Camel, we said, "Hang it all, let's celebrate!" So here's an Anniversary Offer nobody can resist. Three posters (frames not included) of three nostalgic Camel ads. It's our way of reminding you that the taste and quality of Camels have been worth walking a mile for since 1913. It's your way of decorating a game room, a playroom, a bar with handsome, authentic reproductions of these three Camel classics. ***Plus 2 empty Camel packs.**

Mail to: CAMEL Poster Offer P.O. Box 9126, St. Paul, Minnesota 55191 G

Please send me _____ CAMEL Poster Set(s). I enclose $1.00 (no stamps) and 2 empty CAMEL REGULAR packages for each CAMEL Poster Set ordered.

I certify that I am 21 years of age or older.

Name _____
Please Print Plainly

Address _____ Phone No. _____

City _____ State _____ Zip _____ (Required)

Allow 4-6 weeks for delivery. Offer expires January 31, 1974.
Offer is limited to U.S.A. and is not valid where prohibited by law.

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

25 mg. "tar," 1.6 mg. nicotine av. per cigarette, FTC Report FEB.'73.

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The Club
Dodge, and only

Only Dodge gives you the Club Cab, with 34 cubic feet of extra storage space behind the seat.

Neither rain nor snow nor heat of day nor dust of road will touch your valuable belongings again. Because the Dodge Club Cab gives you 34 extra cubic feet of space behind the seat to keep all those things you don't want to leave outside inside. Things such as expensive tools, or fishing tackle, or golf clubs. Even things such as kids, if you have the optional jump seats with seat belts for the back. Electronic Ignition and front disc brakes come standard, too. The versatile Club Cab—only Dodge has it.

See the 1974 models at your Dodge Truck Dealer's soon.

Copyrighted material

Cab. Dodge, has it.

CHRYSLER
MOTORS CORPORATION

Dodge
Dodge Trucks

You get this much extra space behind the seat.

For extra things.

For extra people.

EXTRA CARE
IN ENGINEERING
MAKES A DIFFERENCE.

**DODGE TRUCKS.
DEPEND ON 'EM.**

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All the chain saw you need costs just

$99.95*

It's the 6.9 lb.** Mini Mac 1. Only McCulloch makes a saw this light, for this little.

The right tool for the right job—you know that's what counts. So if all you use a chain saw for is limbing, trimming and cutting firewood around your own yard — this is *all* the saw and *all* the power you need! It's lighter than any saw in the world for the price. Its 10" bar will cut a 6" log in just 5 seconds and even zip through 20" logs. And it comes with something you just can't acquire anywhere else —McCulloch's 26 years of professional chain saw engineering know-how. When you can get a McCulloch for $99.95 why pay more?

If you have bigger jobs, or heavier cutting, check this chart. McCulloch has the right saw for every job.

McCulloch Model	Best For	Weight**	Engine	Bar	Price*
Mini Mac 1	All the saw you need for the average yard.	6.9 lbs.	1.8 cu. in.	10"	$ 99.95
Mini Mac Electric	Can be used outdoors as well as indoors.	7¾ lbs.	110V, 60 cycles, 12 amps, double insulated.	10"	$ 99.95
Mini Mac 1 Automatic	Longer bar for bigger logs, wood and heavier cutting.	7.1 lbs.	1.8 cu. in.	12"	$119.95
Mini Mac 6 Automatic	Deluxe hand grip and longer bar for heavier cutting.	7.1 lbs.	1.8 cu. in.	14"	$136.95
Power Mac 6 Automatic	More power for orchards, ranches, farm jobs.	6.9 lbs.	2.0 cu. in.	14"	$169.95
Mac 10-10 Automatic	"Sound silencer" for heaviest ranch and farm work.	12.4 lbs.	3.3 cu. in.	16"	$194.95

See your McCulloch dealer—He's listed in the Yellow Pages under "saws."

McCulloch McCulloch Corporation, 6101 West Century Blvd., Los Angeles, Calif. 90045

**Manufacturer's suggested list price, including bar and chain. Prices slightly higher in Canada and Alaska.*
***Weight less cutting attachments.*

Recreation

. . . on the go with PS—

Bicycles at college—and in peril

Drexel University of Philadelphia, Pa., recently set up a research group to take an in-depth look at the recreational and transportation aspects of bicycling and walking. They will explore the possibility of converting abandoned railroad and utility swaths into biking and hiking facilities—a concept we'd like to see quickly implemented.

Looks like we'll need all the new bikeways we can get. Riding in cities used to be perilous only because of traffic. But during a recent bike race in New York City's Central Park, several riders were mugged and their bikes stolen. Perhaps manufacturers will have to start making bicycles-built-for-two again to provide for a shotgun-rider's position.

Van conversion raises the roof

Clarence B. Kauffman of Atglen, Pa. built this expanding top for his van, and is in the process of patenting the idea. Kauffman stiffened the roof of the Ford van, which was cut and reattached with a piano hinge so that it could cantilever out. Inside (top photo) there is 9′ headroom to the peak of the tent.

The bunk is 11′4″ long and 5′5″ deep. It can hold up to 300 pounds before you need to support it.

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Roundup

on and off the road

By HERBERT SHULDINER

A mini-motor home that's really small

The new Escort motor home fits into a new niche—somewhere between the true mini-motor home and the van conversion. Contempo Campers, 8500 Lankershim Blvd., Sun Valley, Calif., reports that the Escort motor home weighs only 5960 pounds. Yet the small RV is fully self-contained and can sleep up to five persons, if you buy the optional extra bunks.

New type of powerboat racing

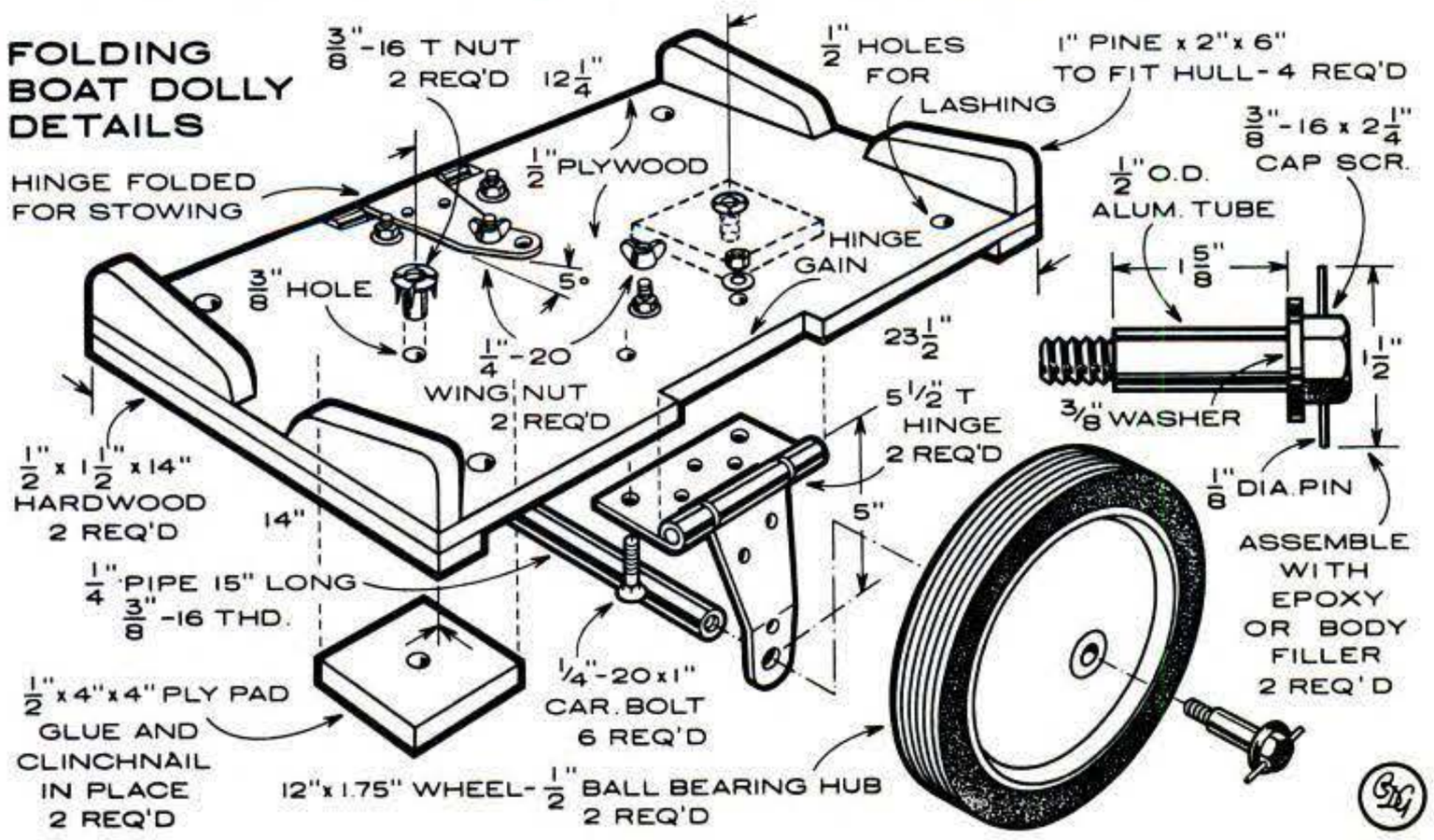
Turning road bugs into water bugs is increasing in popularity. Some Ohioans have formed the Waterbugs of America Racing Association to promote their sport in which special production model VWs are adapted for water. The W.A.R.A. is preparing a 1974 Liquid Grand Prix.

Snowmobiles stay noisy

The New York state legislature quietly revised its snowmobile law recently, postponing tough reduced noise-level standards for snowmobiles for five years. A 73-dBA limit was scheduled to cover 1975 models. This is now put off until 1980. The limit will be cut to 78 dBA for 1975.

For the do-it-yourself outdoorsman

This folding dolly helps you wheel your boat down to the water from your car or campsite without sweating it. Designed by Daniel A. Green of Pittsburgh, it's simple to build from the plans below. The size of the dolly is determined by the stowage space under the front seat of your boat. Note that axle detaches, wheels come off to store flat on tray. If the launch route is rough, you can use four corner holes to fasten unit to the keel amidships.



Power to go

McCulloch Portable Generators

Here's electric power where you need it, when you need it — on camping trips, outdoor building projects, for standby power during storms, blackouts and other power emergencies. McCulloch's super lightweight generators are small enough to fit in the back of your car. And the unique design, with only one moving part, means they're the most reliable you can buy. Three sizes, all with our Double Warranty.

See your McCulloch dealer — He's listed in the Yellow Pages under "saws."

H-1500. 1,500 watt capacity. 68 lbs. 115 volts. 60 cycles. Only **$199.95***

H-2000. 2,000 watt capacity. 83 lbs. 115 volts. 60 cycles. **$289.95***

H-3000. 3,000 watt capacity. 129 lbs. 115 or 230 volts. 60 cycles. **$399.95***

McCulloch

McCulloch Corporation
6101 West Century Boulevard
Los Angeles, California 90045

**Manufacturer's suggested list price. Slightly higher in Alaska and Canada.*

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Look and Listen

News, comment, and opinion from the world of home-entertainment electronics

By C. P. GILMORE

Cartrivision—end of the line?

In the year and a half since it was put on sale [L&L, Apr. '72] the Cartrivision home video recorder-playback machine has never lived up to expectations. So last March, the company decided to try what industry observers called a "do or die" promotion in California. Together with Sears and Teledyne Packard-Bell, the company launched a hard-sell program and budgeted up to $5 million for an all-out advertising campaign.

A few months ago, just as the program was beginning to pay off in sales, the company ran out of money, couldn't pay its bills, and announced that it was halting all production and filing under the bankruptcy laws. It asked the court for protection from its creditors while it tries to reorganize. Cartrivision hopes to stay in business, its officers say. But it needs time to find an additional $7 million in capital. Meanwhile the company is continuing to sell cartridges and spare parts, and the cartridge-rental network that was set up last year is in operation.

While CTI may yet manage to find the money it needs, the announcement has certainly cast a pall over the video-cassette market. Two years ago CBS shut down its EVR operation—the country's pioneer video-cassette venture—and wrote off $10 million in development costs. A little while later Ampex announced that its Instavideo system was being scrapped. Now CTI is in trouble.

There are some bright spots in the field. Sony's U-Matic system, which has been sold to business and industry rather than individuals, is a solid success. RCA is preparing to market its SelectaVision Magtape system [L&L, June '72]. And several companies are working hard to perfect videodiscs. But Cartrivision, pioneer in producing a videotape system for the home and still the only company on the market with both blank-tape-recording capability and a large library of prerecorded material for both purchase and rental, and the only company promoting its products for use by the general public, is in trouble. If it fails, the whole field will suffer.

A new beginning?

In this column in June 1972, I reported on a revolutionary new video-recording technique being developed by the Digital Recording Corporation and Battelle Development. I now have more details.

The system, which has now been demonstrated to several potential licensees, records a 30-minute color video program on a four-by-five-inch piece of black-and-white film. The signal to be recorded is converted to a string of digital pulses, which are used to turn a laser on and off millions of times a second. A series of spinning mirrors and lenses sweeps the laser beam across a piece of film at high speed, recording the program in an on/off code.

To play the signal back, shine a light through the film, scan it with the same optical system, send the digital signal thus developed through a converter to turn it back into an analog TV picture.

A spokesman for Digital Recording says the playback machine would be suitcase-size and sell for about $200. A 30-minute film program could be reproduced for 50 cents plus the cost of the programing material. No plans for production yet.

Outta sight

Last December I reported on the Nakamichi cassette recorder, which at that time was going to be marketed under the Concord label. It has truly remarkable performance characteristics, but its most fabulous statistic appeared on the price tag—$1100.

While no one has broken that price barrier yet, the cost of top-of-the-line cassette decks has been soaring as the fi gets higher and the decks more sophisticated. Sony's new Dolby-equipped deck goes for $525, TEAC's three-head, three-motor 850X is $580. A Technics high-end model (Technics is the new Panasonic audio label) is $499.95, and JVC's is $529.95.

It's not just inflation. Since tapes are now better and capable of producing frequency response flat out to 18,000 Hertz or so, the tape recorders have to improve to keep up. Thus the three-motor jobs for super stability, three heads so that record and playback heads can each be designed for optimum performance, and the almost univeral use of Dolby circuitry to quiet hiss.

Does anybody remember when the term "cassette recorder" usually meant something under $50?

Nifty new ideas

Four items snared my attention this month:

- MicroAcoustics, a firm that is best known for making recording styli, is now selling a new phonograph cartridge the company says is totally different from anything ever produced before. The new cartridge is neither magnetic nor ceramic, but "electronic." I don't have any details on what that means, except a specification sheet that says the transducer in the cartridge is a "self-energized IC."

  MicroAcoustics says the device is flat to 50 kHz and is the first cartridge that adds no color of its own to the sound being reproduced. The cartridge comes with a choice of styli: the usual elliptical and conical, plus a special stylus designed for CD-4 discs. Price $100 to $120 depending on stylus.
- Onkyo has a new $600 receiver with a small, built-in analog computer. The computer checks the signal the receiver is handling, decides whether it's matrix four-channel or CD-4 discrete, and switches itself to the right mode automatically.
- So far, Sony has made the Trinitron tube only in relatively small sizes; 20-inch was the biggest. Now, Sony has announced the super-sized 25-inch Trinitron, which went on sale in Japan this summer and will come into this country at some yet unannounced time. Superpriced, too: translated into dollars the tab in Japan is $1132.
- When an electronic circuit fails in a spacecraft, there's almost always a backup circuit standing by to take over instantly. Motorola is rumored to be getting ready to market a TV set with the same feature. Presumably, a little light would go on when the primary circuit failed so you could pull out the defective circuit board and have it repaired—while you continued to enjoy TV on the backup circuit. Sounds like a great idea. Only trouble: Motorola won't confirm that the story is true, and the scheme might be expensive.

Nostalgia time

Quick now, what does the name "Atwater Kent" mean to you?

If you're over a certain age, that very phrase should make memories of the A&P Gypsies, Rudy Vallee, and Gene Austin come flooding in. Back in the 1930s when radio was new, practically all home life centered around the cathedral-shaped Atwater Kent radio in the living room.

Well, today there's a new Atwater Kent Company turning out a line of stereo consoles—all in pecan and walnut Mediterranean styling, containing 10-watt-per-channel amplifiers, record changers, and eight-track cartridge players. The name will be familiar, but the A&P Gypsies would never recognize it. PS

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Has hot taste got you down?

Come up to KOOL with pure menthol and the taste of extra coolness.

Kool Milds 14 mg. "tar," 1.0 mg. nicotine av. per cigarette, by FTC method. Kool Kings 17 mg. "tar," 1.4 mg. nicotine; Kool Longs 17 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report Feb. 73.

© BROWN & WILLIAMSON TOBACCO CORP.

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

14 mg. tar,
1.0 mg. nicotine

Now, lowered tar KOOL Milds

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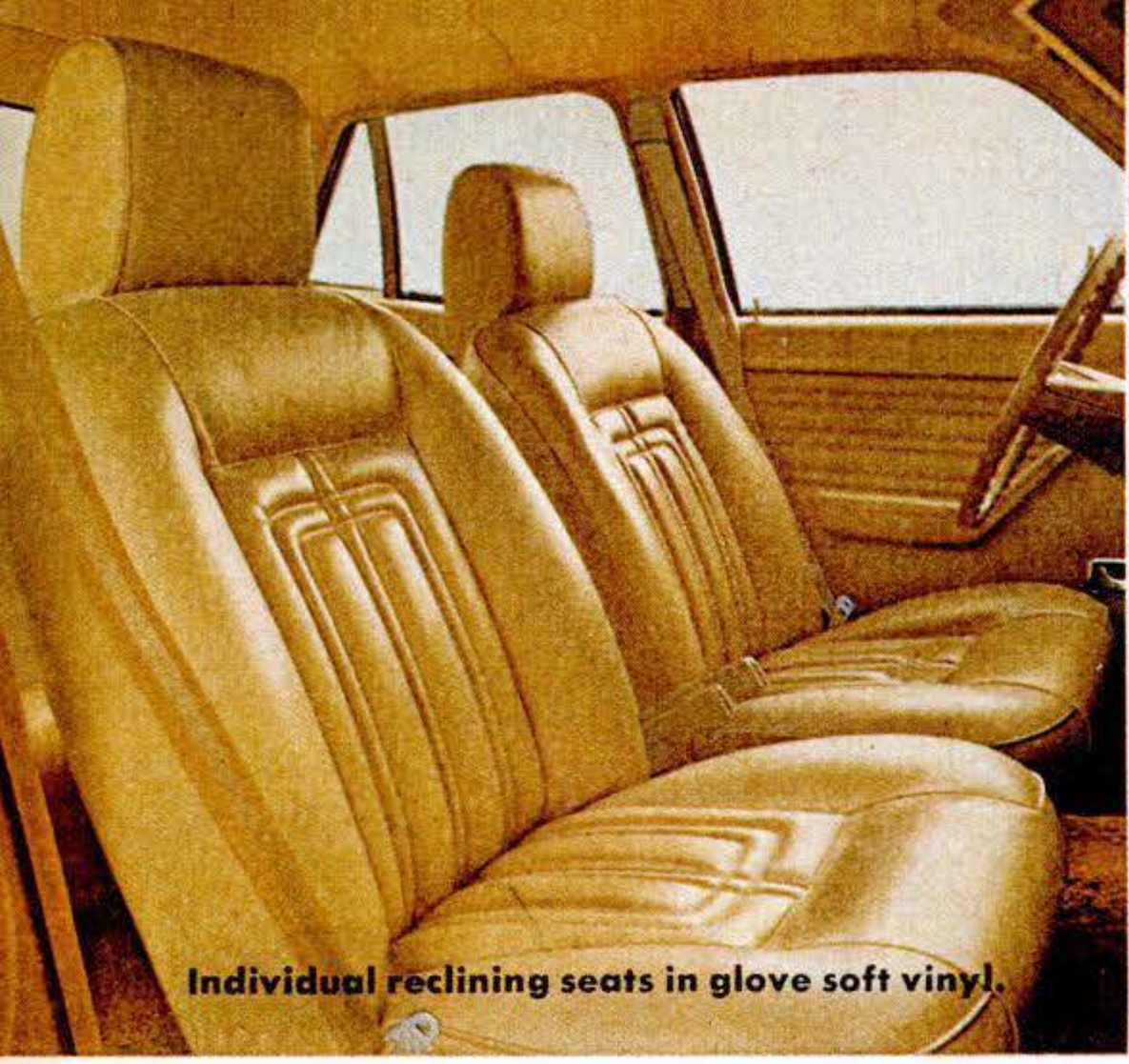
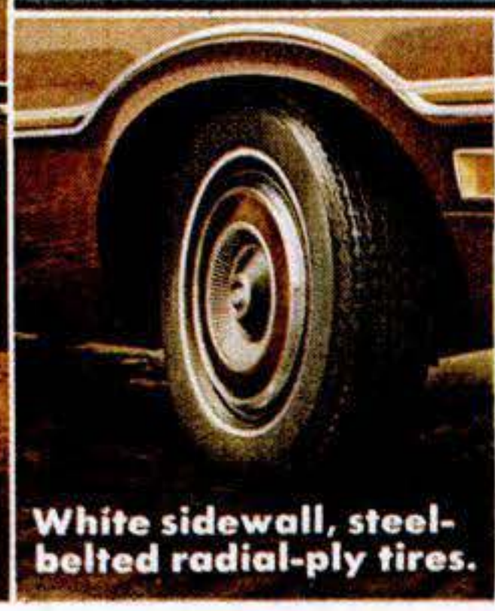
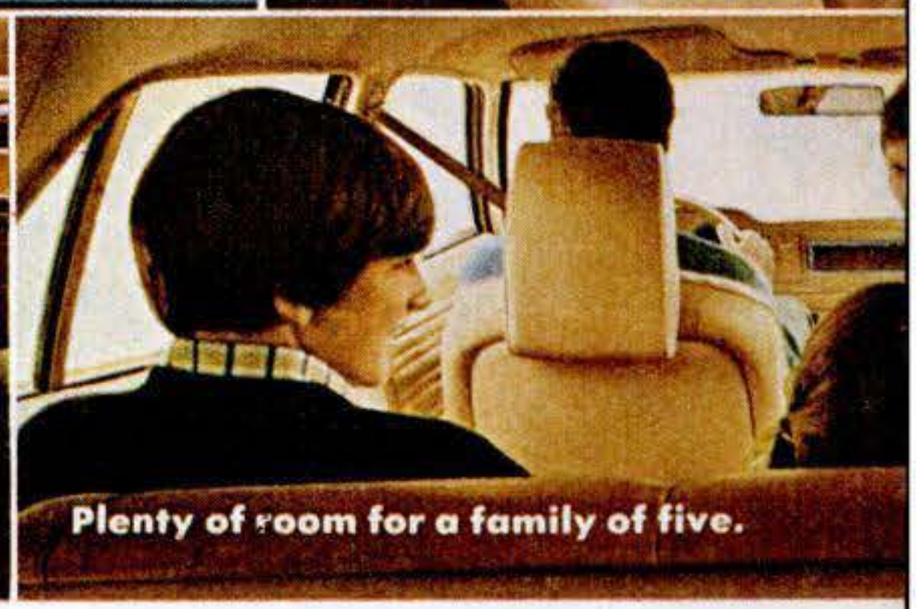

Individual reclining seats in glove soft vinyl.

Grained vinyl roof.

Family-size back seat.


White sidewall, steel-belted radial-ply tires.


Plenty of room for a family of five.

Surprising luxury and comfort in an

Hydrofoil Sailing...

Sail twice as fast as the wind on do-it-yourself foils

By BEN KOCIVAR

Hobie 16 with do-it-yourself foils goes foilborne at about 10 knots. Still to be worked out: remaining foilborne for extended time.

Lateral foils attach to side rails of catamaran with pivot brackets to allow retraction in shallow waters, light winds, etc. In use, foils are clamped down to deck lips. Stern foil also pivots.

Stern foil is mounted to inner rear deck of catamaran's hulls. Clamp, used to hold setting angle of foil, is mounted under rear crossarm exactly in middle. Adjusting lever passes through clamp.

Usually a new boat design doesn't hit the market until it's been all figured out. Now there's a sailboat design so new that you can take part in working out the details. And it's so promising that if you can make it work, you may join that exclusive club of those who have traveled twice as fast as the wind that furnishes the power.

The boat is a sailing hydrofoil. Principle of a foil: Lower an airplane-like structure into the water. It creates lift, raising the hull. That reduces drag and increases speed.

Foils have had considerable success on powerboats. Now foils for sailboats are attracting attention. The Williwaw, a 31-foot hydrofoil trimaran built by David A. Keiper [PS, Feb. '72] has sailed from California to Hawaii with claimed speeds of over 35 mph.

Now Keiper is selling DAK (for his initials) hydrofoil kits that can

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economical family car. Ford Maverick for 1974.

Ford Maverick has always been an inexpensive car to run with a reputation for good gas mileage. Now Maverick with Luxury Decor Option also offers many appointments you'd expect on a luxury car. It's the economical family compact that doesn't ask you to give up luxury. See it now at your Ford Dealer's. The closer you look, the better we look.

FORD MAVERICK

FORD DIVISION Ford

Ready for Liftoff?

be mounted on Aquacats, Hobie 14s and 16s, Venture 15s, and Tornadoes. The kits range from $160 to $395 (DAK Hydrofoils, Box 71, Sausalito, Calif. 94965). Two builders told me it takes about a week's hard work to put the foils together.

There are three foils—one on each side of the boat and one at the stern. Their shape may be seen in the photos. All are designed to pivot upward when not in use: in shallow water, for launching or docking, or in very light winds.

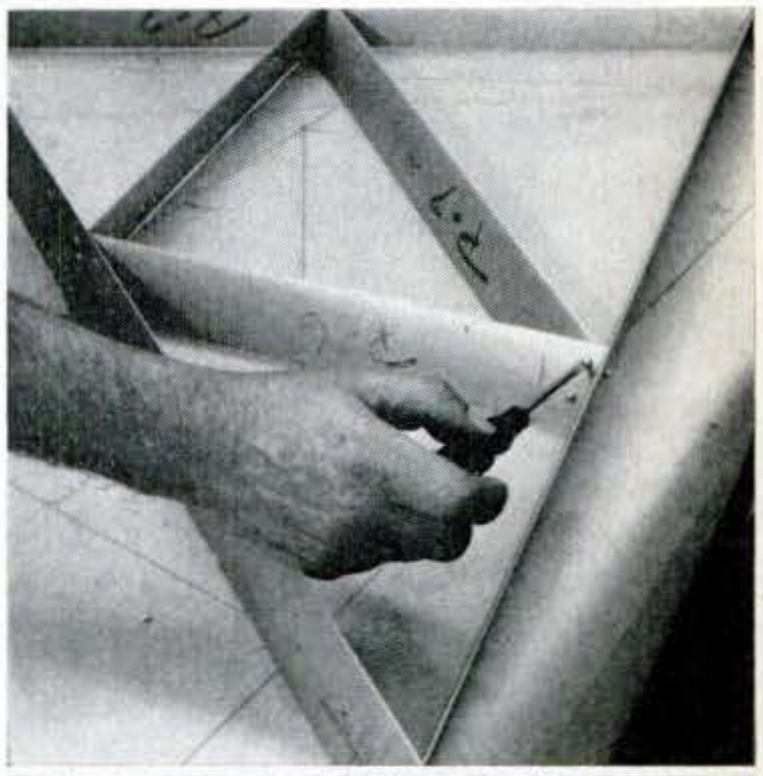
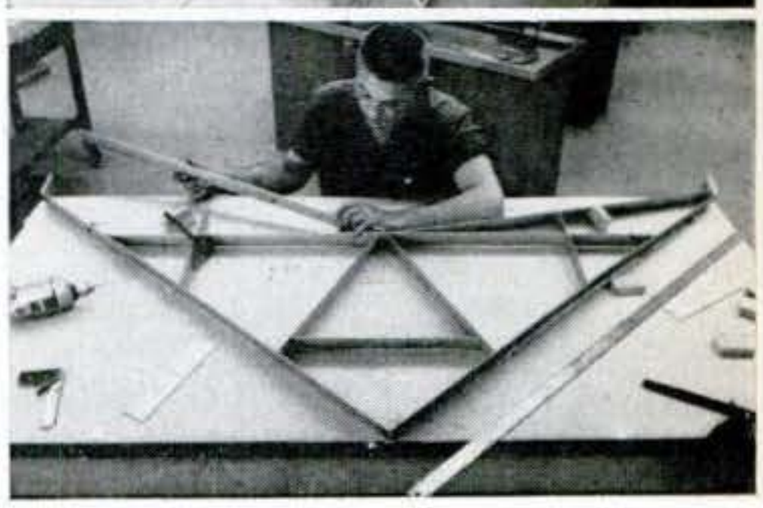
A work in progress. At this point the design could stand some more work. I observed two of the DAK foils in operation recently on a Hobie 14 and a Hobie 16 at Port Jefferson, Long Island. No notable speeds were obtained and the two boats had difficulty remaining foilborne. Yet the promise was definitely there and the problems in remaining foilborne for extended periods appeared to be those of refinement and tuning.

Prof. W. S. Bradfield, head of the engineering department at New York's Stony Brook University, who has been exploring sailing hydrofoil concepts for many years, ran some tow tests with his students on a Hobie 16 fitted with DAK foils.

By dragging the Hobie behind a powerboat they found that up to speeds of 12.5 knots the drag with foils down was greater than with foils retracted. Above that speed there was less drag with foils down. The boat became foilborne at about 10 knots.

Obviously, sailing hydrofoils are in their infancy. But the promise that designers have been talking about is beginning to produce results. For example, at electronically clocked speed trials in Los Angeles Harbor a few months ago, Gary Seaman sailed his 30-foot hydrofoil, Guided Missile, at 17.6 knots in an 11.5-knot wind. On another run he reached an incredible 16.29 knots in only eight knots of wind.

Now foil enthusiasts are preparing to make an assault on the 30-knot barrier, which they may well break in true wind speeds of 15 or 20 knots. And it looks as though the sailing foils will soon be after the John Player prize for the world's fastest boat under sail. PS

DAK "kit" includes aluminum extrusions, bolt hardware, and epoxy and powdered aluminum filler. You cut extrusions using patterns in kit; assemble according to drawings. Close-up (top) shows extrusions being screwed together. A "quick" kit (at $150-$220 extra) comes prebent, precut, and predrilled.

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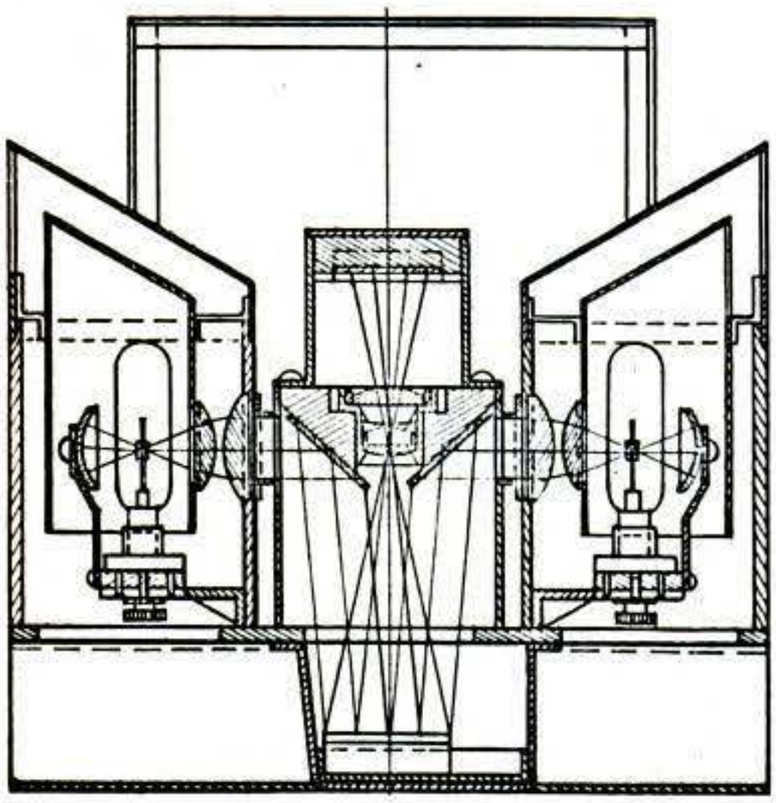
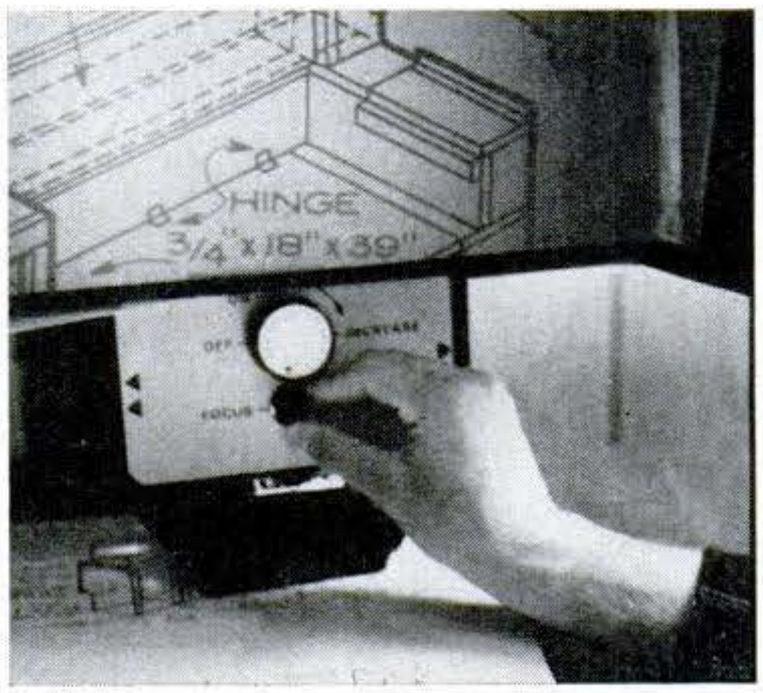
Optiscope Gives a Big Look at Small Print

Magnified four times, details on blueprint inserted by author Swanson show up with no apparent distortion. The 9"-by-14" screen is made of polarized material.



Light goes through condensers to mirrors, bounces down onto object. Reflection bounces off two mirrors onto screen.



Focus control brings near-perfect clarity to picture. Larger on/off knob above it is set for desired illumination.

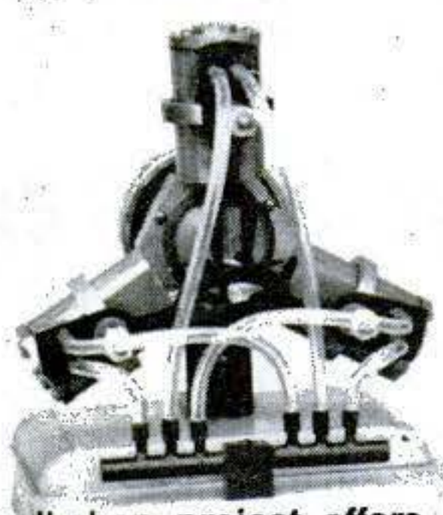
Designed as a reading aid for the visually handicapped, the Optiscope enlarger produces positive images with four-times magnification. Other uses include close-up inspection of textiles, paper, fingerprints, or even bogus bills.

I tried this opaque-type projector and found several convenient features. Enlarger and screen are contained in a single unit. It's compact—16 inches wide, 20 inches long, 18 inches high—and weighs only 14 pounds. The platform that holds the viewing material slides laterally and vertically, and can accommodate books of any size, shape, or thickness. Whether black and white or color, three-dimensional or flat, the image appears on the screen with no visible distortion.

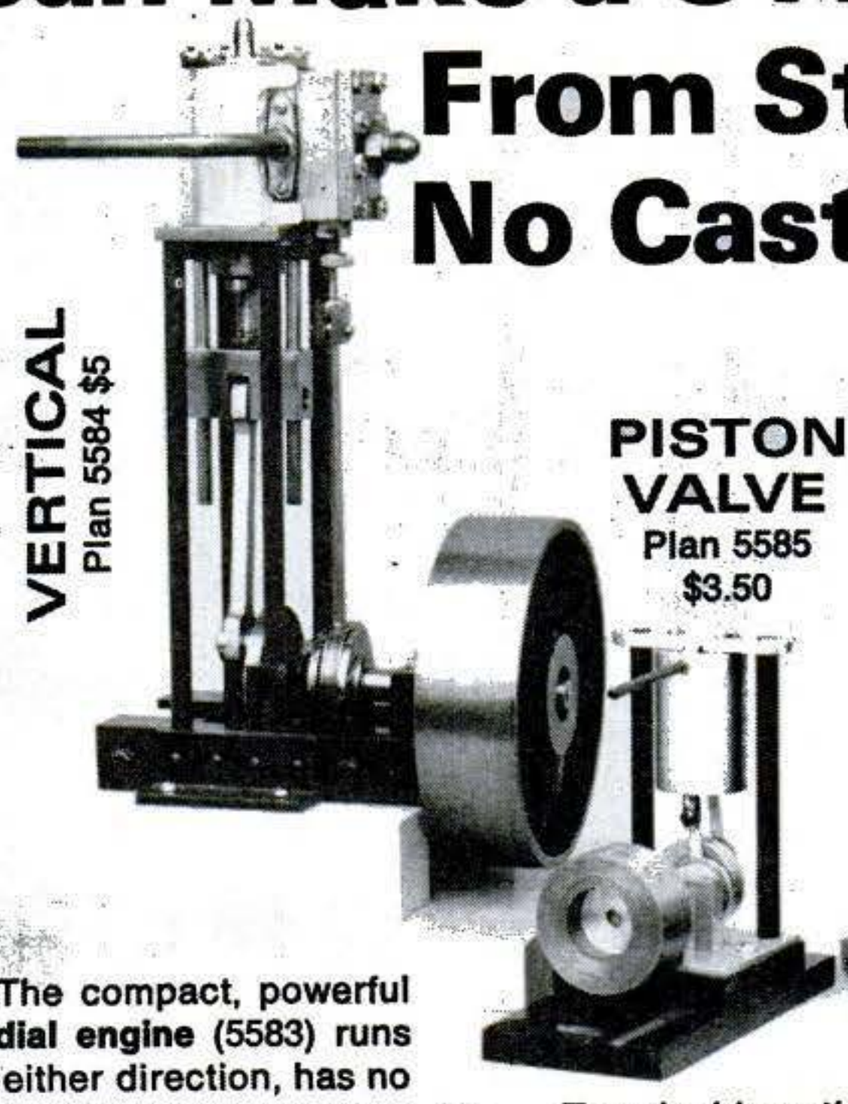
For anyone faced with eye-straining detail the Optiscope far outdoes a magnifying glass in clarity and viewing ease.

The enlarger is priced at $295. It's made by Opaque Systems, Ltd., 100 Taft Ave., Hempstead, N.Y. 11550.—*Erik Swanson*

You Can Make a STEAM ENGINE From Stock Shapes—No Castings Needed!

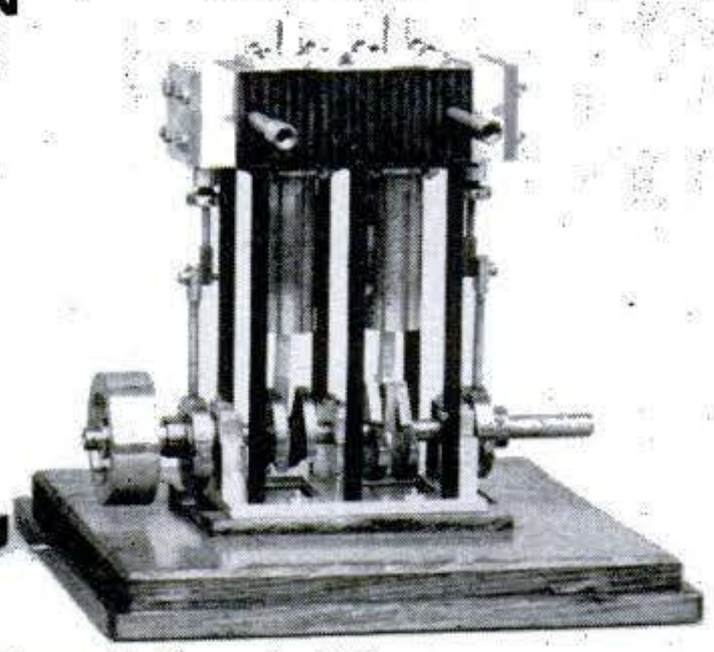


RADIAL
Plan 5583 $3.50



VERTICAL
Plan 5584 $5

PISTON VALVE
Plan 5585
$3.50



MARINE
Plan 5586 $6

No small-shop project offers more satisfaction than the model steam engine. Here are four proven designs you can make without castings. All parts, drawn full scale, can be made from stock forms like bar, tube, and sheet.

For a starter, try Plan 5585, a simple single-action engine based on the fairly modern (as steam engines go) **piston valve.**

The compact, powerful **radial engine** (5583) runs in either direction, has no "dead center" position. Intended for compressed air or low pressure steam.

The larger **vertical engine** (Plan 5584) is challenging enough to satisfy even the experienced builder. Its 1" bore and 1¼" stroke in a double acting cylinder make it a powerful performer.

Two double-acting cylinders in the **marine engine** (Plan 5586) operate on cranks 90° to each other. Thus it starts dependably—ideal for radio-controlled boats. Recommended for experienced builders.

TO ORDER YOUR PLANS, send your name and address (include zip code) with a check or money order (no cash). Ask for plans by name and number. Send to:

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New Ideas from the Inventors

The PS pick of ingenious inventions recently patented

ILLUSTRATIONS BY DANA RASMUSSEN

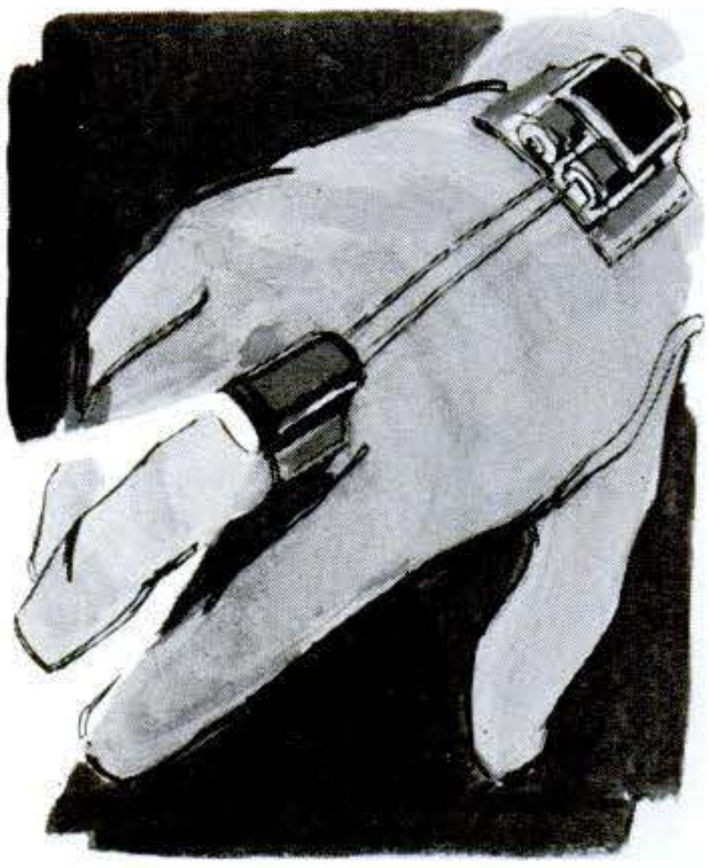
Rubber guard-rail rollers soften barrier crashes

Spaced along one or both sides of a highway, these roller barriers would cushion off-side impact and help to redirect a careening car instead of ripping or brick-walling it. Widest at the top, they'd prevent the crashing vehicle from climbing, keep its wheels on the ground, add their own braking and slowing effect to that of the car's wheels. Barriers might be made out of one-piece cones or properly sized tires assembled on spindles.

Gutter bridge clips to ladder

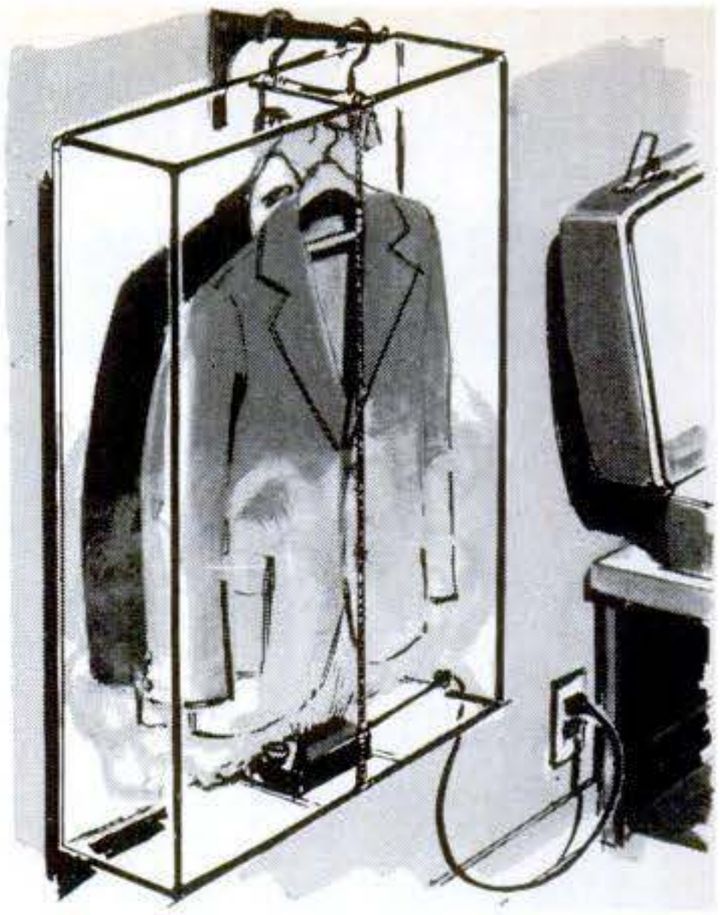
You wouldn't have to damage or weaken your gutters in order to clean them or do other roof work if you clamped supports like these to the tops of your ladder rails. Spring and thumbscrew adjustments would let you set curved, J-shaped fingers so that your weight and the ladder's bear against the inner rather than outer edge of gutter.

Work glove lights your work



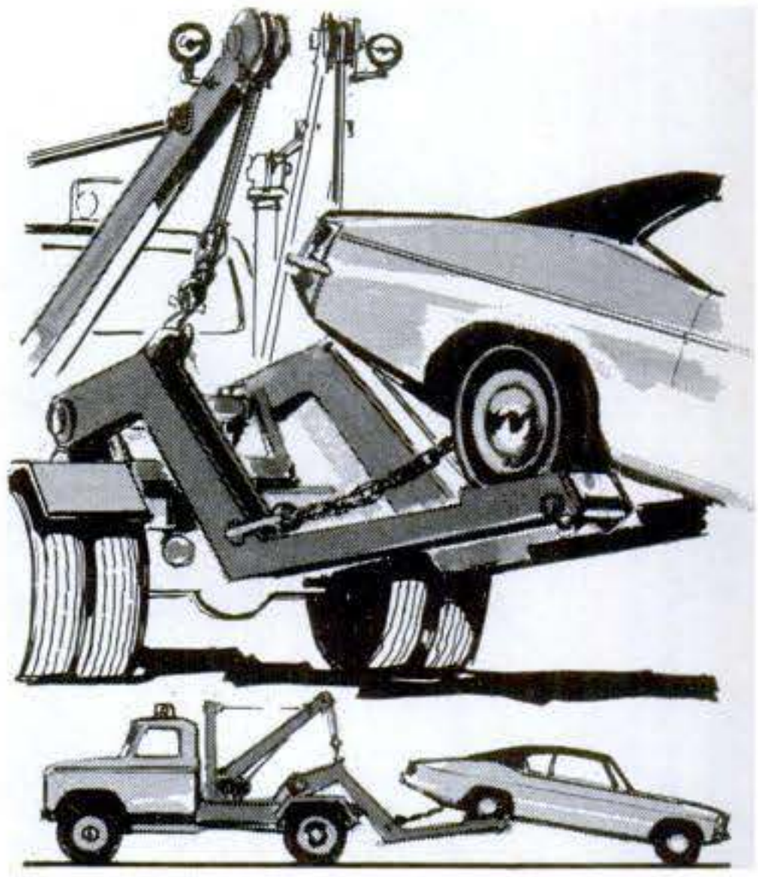
Wired on or through a glove, a finger-mounted flashlight would illuminate work areas and leave both hands free for the job. Battery and switch would be attached to the wrist portion so the light could be turned on or off by a touch of the other hand. Worn on the inside of the hand, the light could also be used as a traffic signal.

Travel bag steams garments



You could steam travel wrinkles out of your clothes quickly and conveniently if you carried them in a plastic folding bag like this. Filled with water and plugged into any electric outlet, the socketed, removable steamer unit would heat and moisturize the interior of the garment bag and quickly freshen the clothes hung out inside.

Tow-truck platform lifts car



Standard means of jacking and towing disabled or illegally parked cars often cause dents, scratches, or more serious damage. To avoid them, this platform tow would be rolled under a car's rear wheels, then tilted to raise them off the ground. Towing would often be possible without breaking into a locked car to shift it to neutral.

The following patents have been issued on these inventions:

Crash barrier—*No. 3,602,109 to D. C. Harrington, Denver;* **Gutter bridge**—*No. 3,603,431 to A. E. Nameche and W. F. Norton, Lima, Ohio;* **Glove light**—*No. 3,638,001 to M. H. Bain, Palos Hills and M. R. Bucher, Hickory Hills, Ill.;* **Garment steamer**—*No. 3,594,917 to G. L. Montgomery, Bountiful, Utah;* **Tow platform**—*No. 3,599,811 to W. F. Watkins, Canoga Park, Calif.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D. C. 20231, at 50 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

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The carton end panel will be applied toward the purchase of the car.

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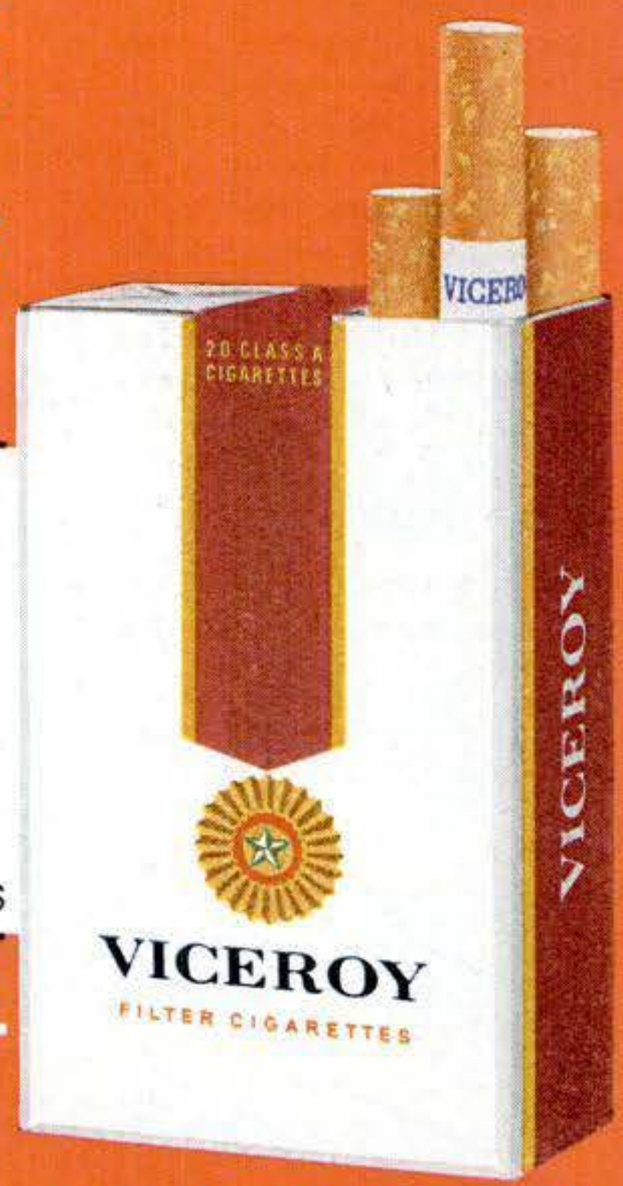
Offer expires December 31, 1973

PS



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King Size, 17 mg. "tar," 1.2 mg. nicotine; Long Size, 18 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report Feb.'73.

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The View Down the Road

. . . news and comments on cars and driving

By JAN P. NORBYE / *PS Automotive Editor*

Whatever happened to the brake-performance standards?

In March '72 I wrote a three-page article saying that standards imposing maximum stopping distances were coming, and would be in force from September 1, 1973. As you know, they're not. First, they were delayed to September 1, 1974, and the 60-mph stopping distance went from 185 feet to 194 feet. Last May the DoT gave Detroit another 12-month extension, to September 1975, and the 60-mph stopping distance shot up to 204 feet.

That may seem disappointing to all of us who like good brakes—and depend on them. But the explanation lies not in a change of heart in Washington—just in better understanding of the mathematics of mass production. For if the industry will guarantee that 100 percent of new cars will stop from 60 in 204 feet or less, about 90 percent will actually stop in about 160 feet, with the remaining 10 percent scattered from 130 feet to 190 feet—and a possible black sheep up around 200 feet.

Hydraulic-pump power brakes

We have often complained in our auto-test reports that power brakes are slow to come on. There can be a delay of 0.6 to 1.0 second between the moment your foot depresses the pedal and the start of actual braking. That's caused by slow pressure build-up in the vacuum booster. Manifold vacuum is being used for too many purposes (mostly connected with emission controls) to be trusted with something as vital as power assist for the brakes, especially on heavy cars.

A couple of years ago the brake engineers at Bendix saw what would have to be done—find another power source—and they developed the Hydro-Boost, which works off the power-steering pump.

Smaller booster—double press

With hydraulic power, the braking lag is cut to a minimum, because the master-cylinder pressure is almost doubled (over 2500 psi against about 1400). With higher pressure, the brakes come on quicker.

Hydro-Boost uses power only during brake application (about one cubic inch per cycle) and uses no power when you keep your foot on the brake while the car is stopped. Is it fail-safe? In case of power-steering failure, there is a direct mechanical linkage between the brake pedal and the master cylinder. You don't lose your brakes; you only lose your power assist.

But will Detroit buy it? Ford has made Hydro-Boost standard on the '74 Lincoln Continental.

Four-wheel disks on '74 Imperial

I am convinced that Ford will switch to Hydro-Boost as soon as Bendix can supply enough of them for all the full-size cars. I also expect Chrysler and GM to develop their own hydraulic brake boosters and get them in production as quickly as possible.

Chrysler Imperial has the greatest need for higher-pressure power assist, since the '74 model has disk brakes both front and rear (and disks depend entirely on line pressure, as they have no self-energizing effect). With four-wheel disks you get better front/rear balance in your brakes under all conditions, since rear disks will give the same basic performance as the front disks throughout a wide range of operating temperature.

Rear disks are less susceptible to premature locking (due to absence of self-energizing). Brake-pad life is up to 50 percent longer than in a disk/drum combination. Rear disk brakes with lower sensitivity to water will perform a fuller share of braking duties in wet weather. Metering valves to restrict rear-wheel line pressure can be eliminated if rear disks are fitted.

I want to congratulate Chrysler on taking the step to four-wheel disks, and hope they will soon be extended to other car lines. The other car makers have lots of experience with four-wheel disks, too (GM from the Corvette, Ford from the GT-40 and its successors) and could easily put them in production.

Water-cooled V8 from Porsche

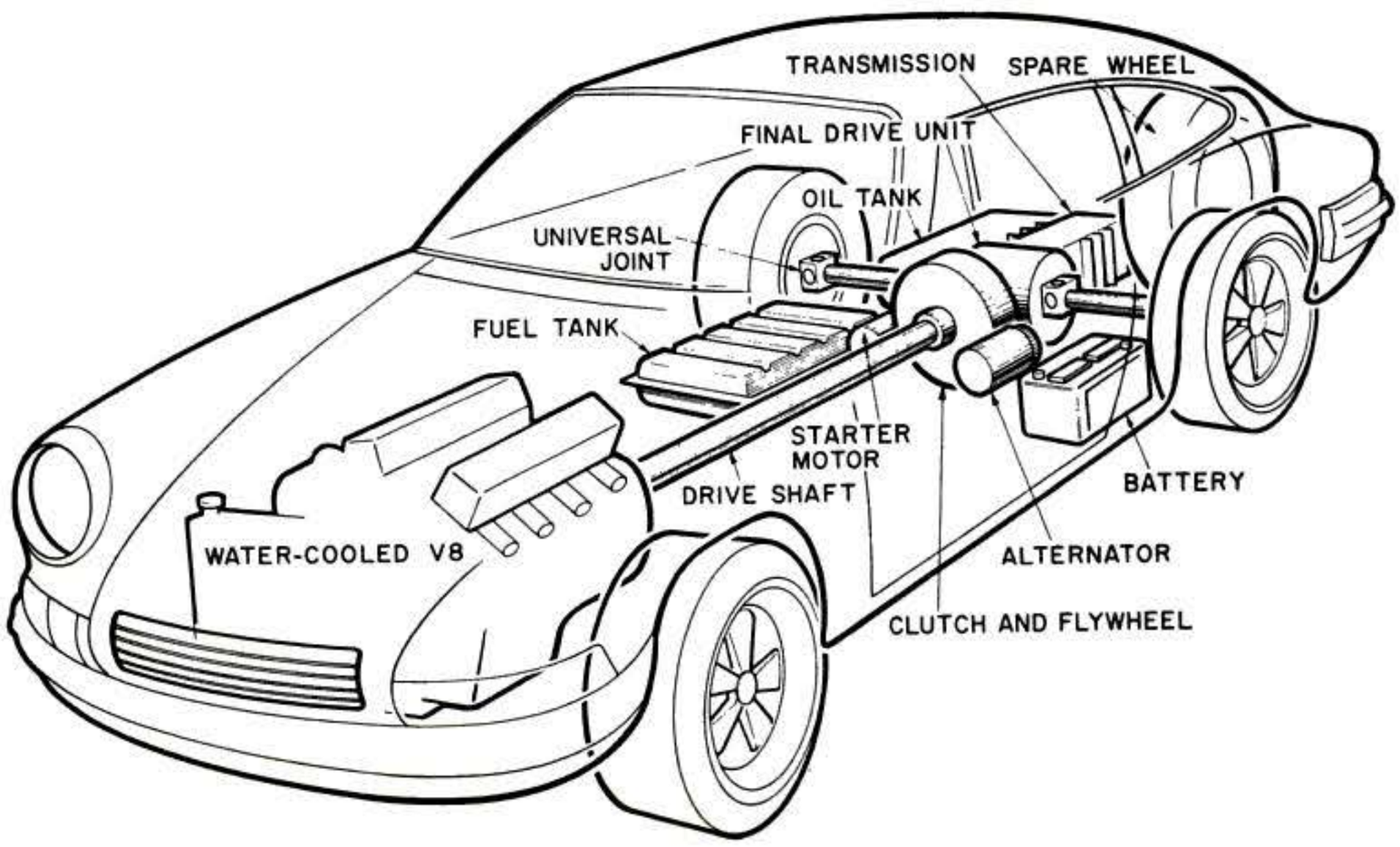
Famous for its air-cooled engines mounted in the tail, Porsche is preparing a major change. Not in its philosophy, but in its products. Porsche cars have grown in size and weight, and the advantages of air-cooling are not only lost above a certain point (say 2.2 liters or 135 cubic inches) but there's a cost penalty as well.

Water-cooling was the cheapest way to get more power, and Porsche engineers do not want a heavy water-cooled engine in the back of the car. So the engine is moved up front, and the future Porsche V8 looks almost conventional.

Many unusual details patented

Look more closely at our drawing of what the V8 Porsche may be like. It's based on recent patents taken out by the company. It's apparent that Porsche wanted to keep a maximum of mechanical elements in the rear for reasons of weight distribution (maintaining a high polar moment of inertia and retaining the typical Porsche handling characteristics).

There's a transaxle, and even the clutch and flywheel are back there. Starter motor and alternator flank the clutch housing. The battery sits on one side, fuel and oil tanks on the other, at floor level, or below, for lowest possible center of gravity. This disposition of the elements frees a lot of front-seat leg room. It should be an exciting car, but you'll probably have to wait another year or so for it. As for price, you can expect $10,000. PS



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The Great Escape

Comin' at you—the famous Jeep® CJ-5, the ultimate get-up-an'-go machine. Get a hold of one of these babies, like this sporty Jeep Renegade and you're in for the ride of your life.

She was born to run free far from the pavement. Built to take hard knocks in her stride, the Renegade boasts a brawny suspension, heavy duty axles and a tight 32.9 ft. turning diameter. Roll bar, fender lip extensions and special aluminum wheels come with this spirited beauty. Plus 304 V-8 engine, improved brakes and a dazzling assortment of colors and options.

'74 Jeep Renegade for a really great escape.

Jeep CJ-5

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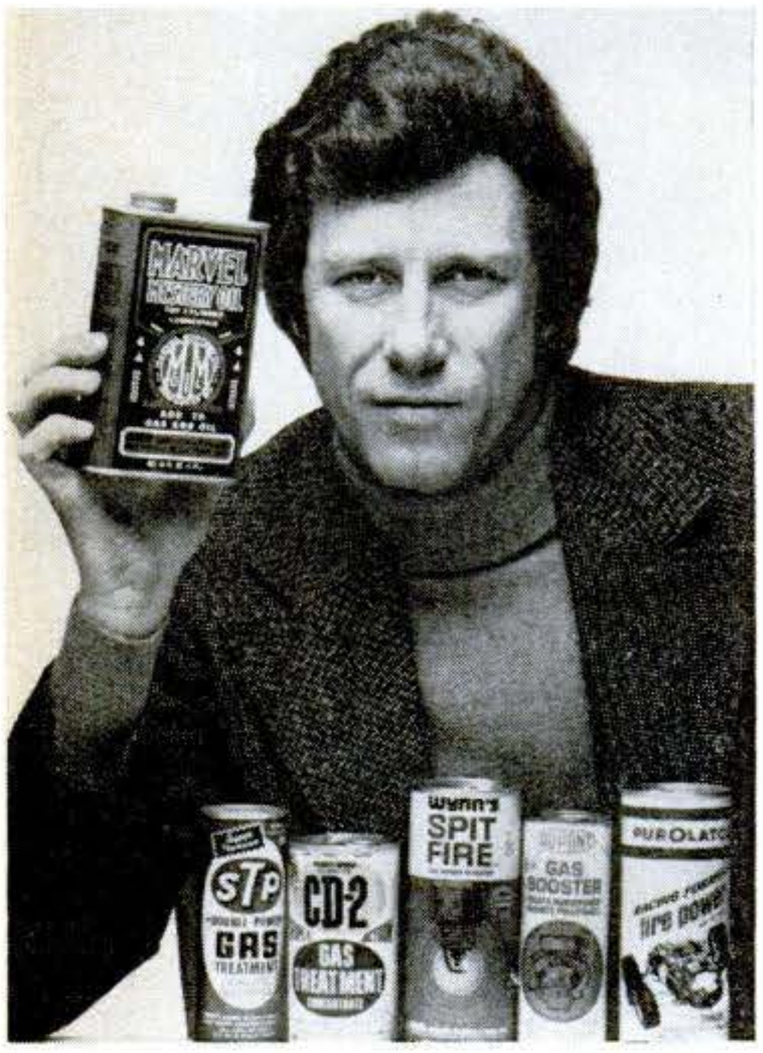
Let's talk about pollutants and car performance



We say just about every gasoline additive is worth the money.

But let's talk about our own. Marvel Mystery Oil. We've conducted an independent lab test that proves Marvel Mystery Oil cuts pollution when added to gasoline in old and new cars. It reinforces lubrication in upper cylinder areas where heat can reach blistering temperatures. And lubrication lasts after combustion is over.

Marvel Mystery Oil. More complete combustion. A cleaner engine. Longer plug life. Better performance. And more mpg. Test data on request.

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The "today" additive in a 50-year-old can.

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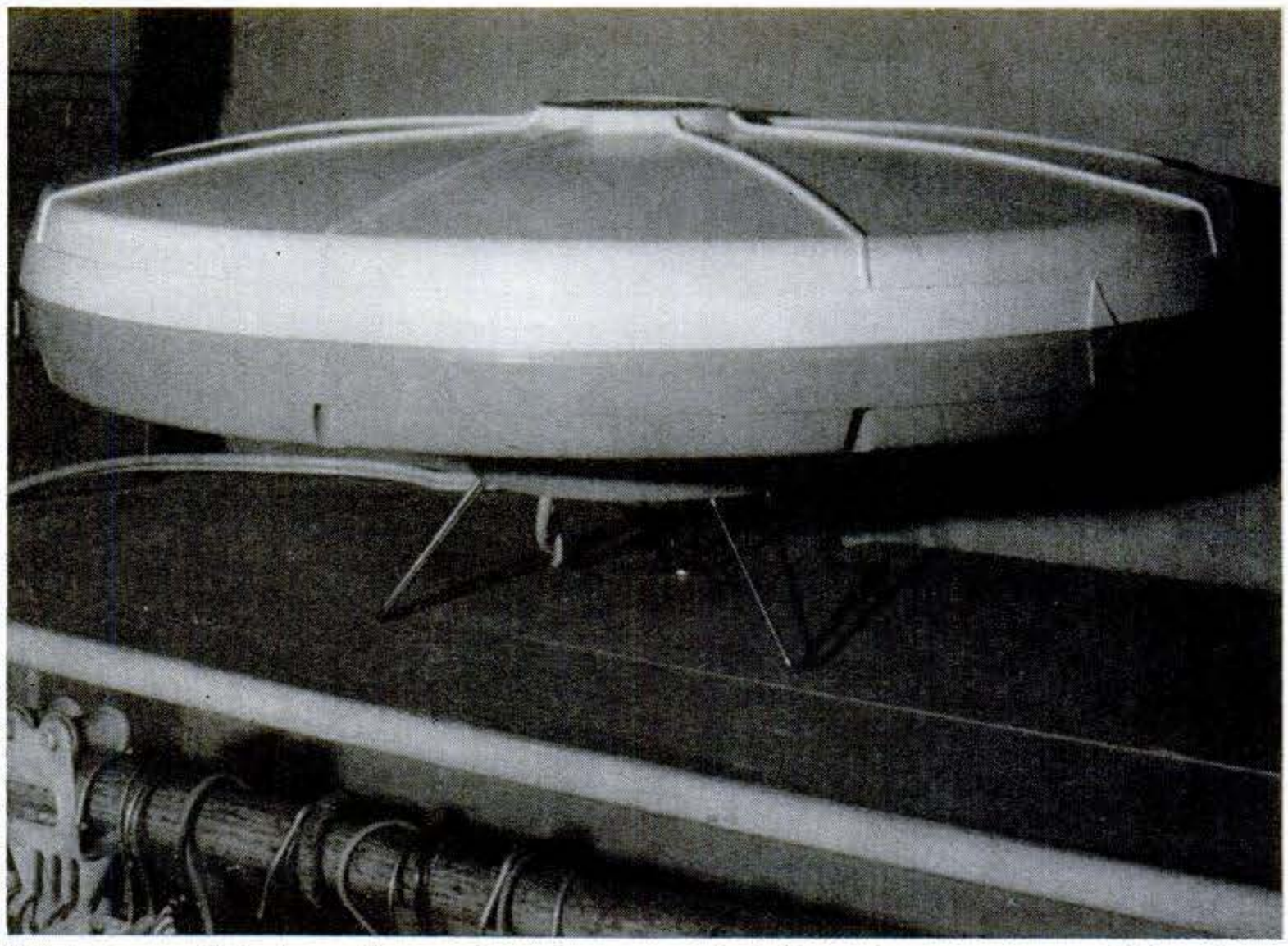


Mini-State "Radome" can sit on legs on a shelf or perch on a pole on your roof. It'll work, too, on an RV or boat within 35 miles of a transmitter.

For Sharper TV: RCA's 'Flying Saucer'

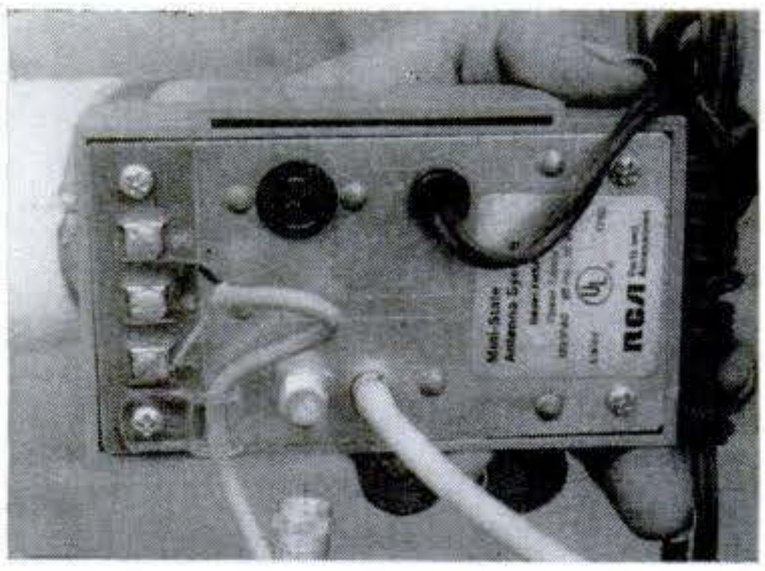
That 21-inch saucer in my closet is no indication that mini-Martians have landed. Rather, an RCA Mini-State antenna has settled there.

Inside that "Radome" (their name for it) are a dipole, reflector, and five directors for UHF reception. Two metal bands suck in VHF. There are also an amplifier and a motor (to rotate the innards).

Along with the saucer, you get a power-supply unit, a band separator, and a control unit. The control unit is pure fun. Press the rocker switch to start the antenna elements rotating, and sectors light up to show you which way the highly directional antenna is aiming.

Hooking up is a 15-minute screwdriver job—longer, of course, to mount the saucer on your roof. RCA likes that roof idea (the higher you put the thing, the better, they say). Still, it worked surprisingly well at both nonroof sites where we tried it: in my brownstone house six miles from New York's TV transmitters, and in PS's steel-skeletoned office building—normally a disaster area for TV reception.

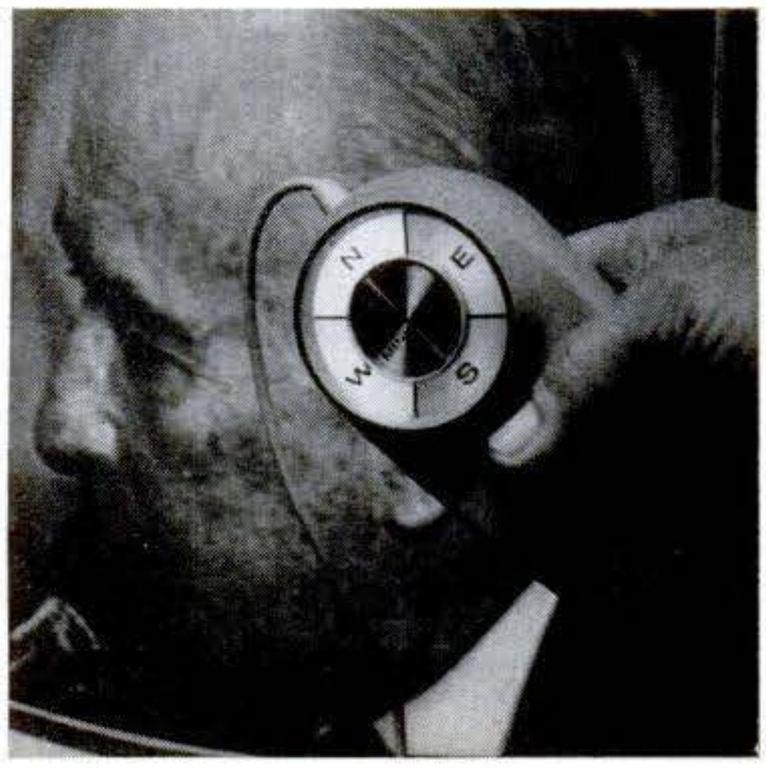
We like the Mini-State for city or suburban use, if you don't have a standard TV antenna. And it could be mighty useful on your rec vehicle or boat in camp or at dock where 115VAC is available. It's $100 ($75 without rotator).—*E. H. Ortner*



Power-supply unit is connected to antenna by a special coaxial cable.

Band separator leads replace leads of old antenna at TV terminals.

Sectors of control unit light up to show aim of antenna as it rotates. If you have only one TV source, you don't need it.



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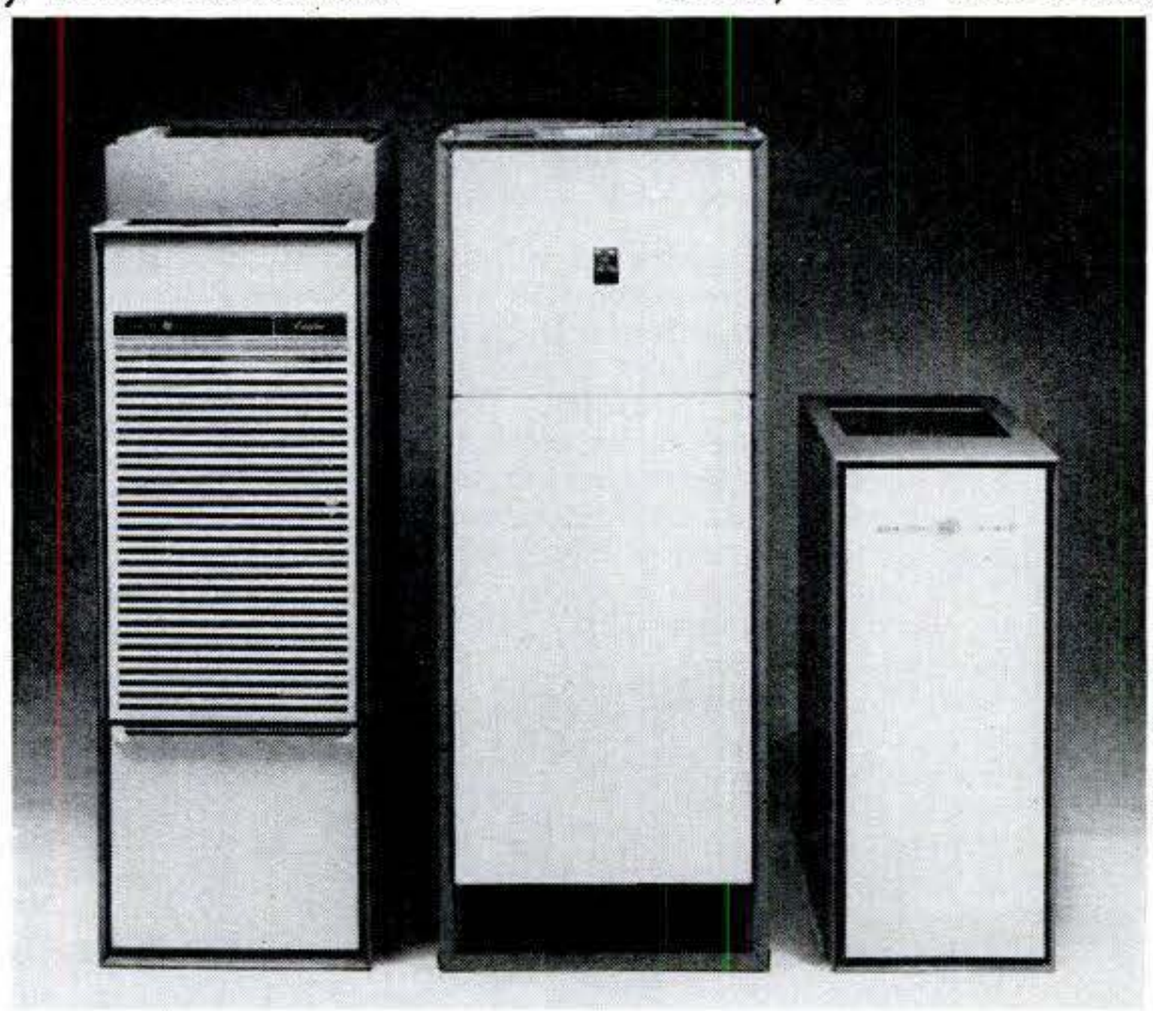
Why take a chance on a furnace you never heard of when General Electric has oil, gas and electric furnaces?

A furnace is a purchase you are going to have to live with and depend on for a great number of years. So, wouldn't it be foolish to buy one you never heard of when you can get a General Electric furnace with all of GE's quality for years of dependable service?

GE does have just about any kind of furnace you can imagine. Fifty-six gas-fired (natural or propane), 11 oil-fired, and 5 electric. Seventy-two different models in all.

You can choose from furnaces that fit into basements, utility rooms, crawl space, attics, alcoves, even closets. Upflow, Downflow, Horizontal furnaces, and Lo-boys, too.



All of these have certain things in common. They're attractively and functionally designed, dependable, quiet, filter-fitted for clean air, convenient to service and to operate.

And every single one of them is eligible for the General Electric Central Air Conditioning National Service Contract Plan.

If you're in the market for a furnace now, or in the future, the man to talk to is your General Electric Central Air Conditioning Dealer.

You'll find him in the Yellow Pages under "Furnaces, Heating; or Air Conditioning Equipment and Systems."

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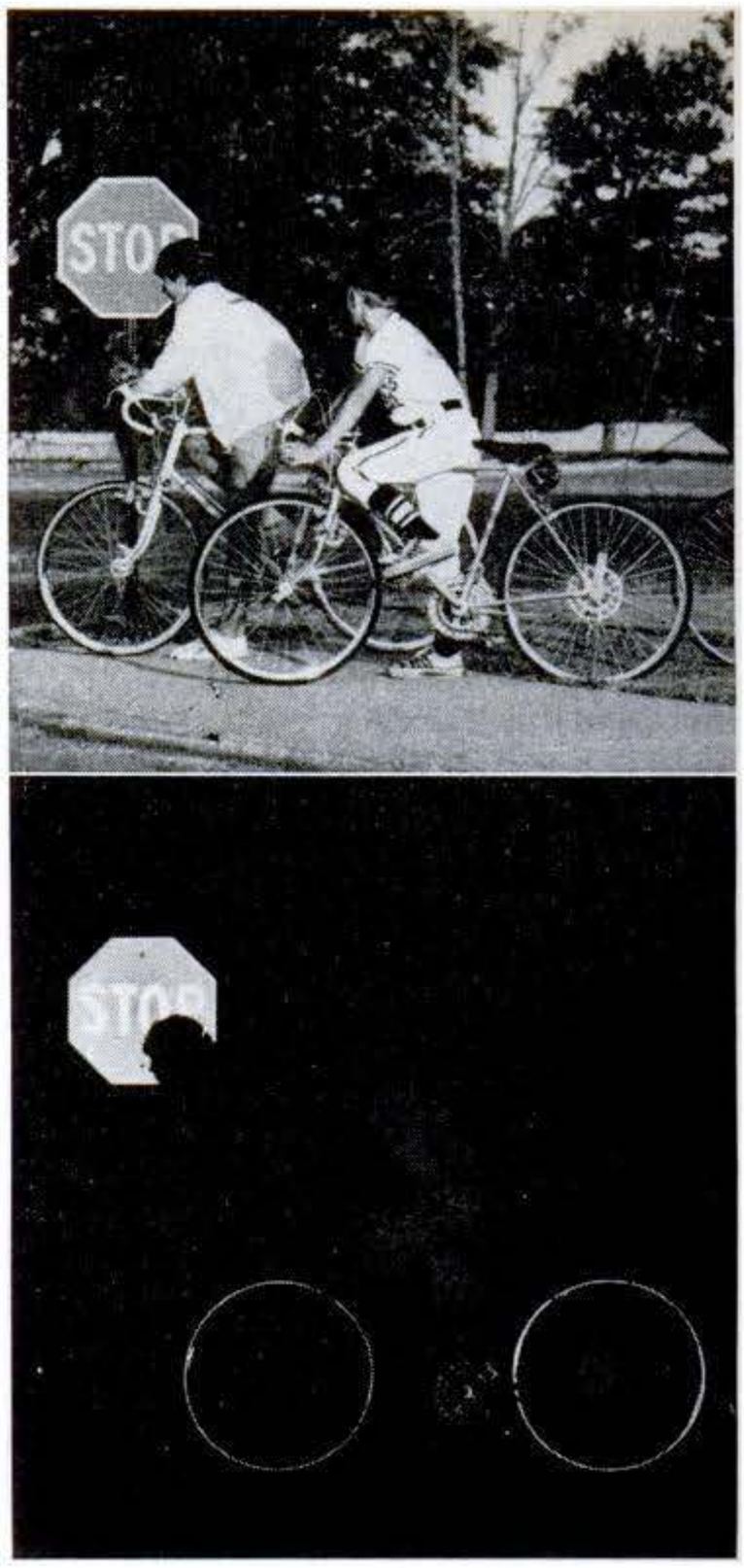

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Finance it at your credit union. You'll find their low annual percentage rate helps keep your family budget running smoothly. There's a minimum of red tape. At your credit union, you're more than a customer. You belong.

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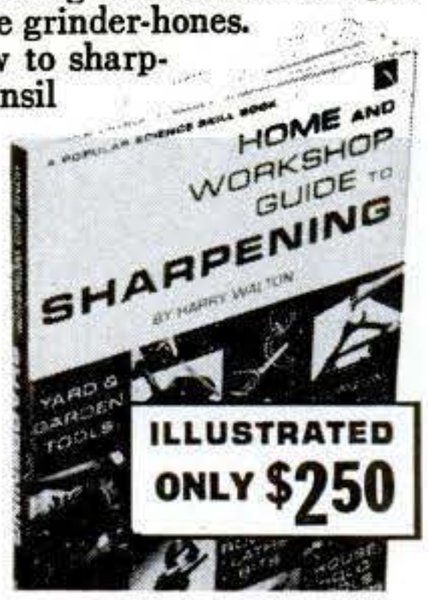

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Money back in 10 days if not fully satisfied.

Bike Tires That Glow in the Dark

Can you spot which bike, in the two pictures above, has the reflective tires?

The one with the sidewalls that light up in the dark has Glowall tires, a new product by Goodyear Tire & Rubber Co. The glow comes from 3/16-inch-wide strips of reflective tape that are molded into the sidewalls.

In daylight, the tires look like ordinary bike tires, but with an added thin, silvery sidewall. At night, the strips light up when the bike crosses before the headlights of a car—visible, says Goodyear, up to a block away.

The tape is composed of millions of microscopic glass beads—the same material used for reflective traffic signs. It doesn't wear out, and can't be removed. It is made for Goodyear by 3M.

Glowall tires are being supplied by Goodyear to other tire manufacturers, too. They come in four sizes and sell for $5.60 to $6.28.

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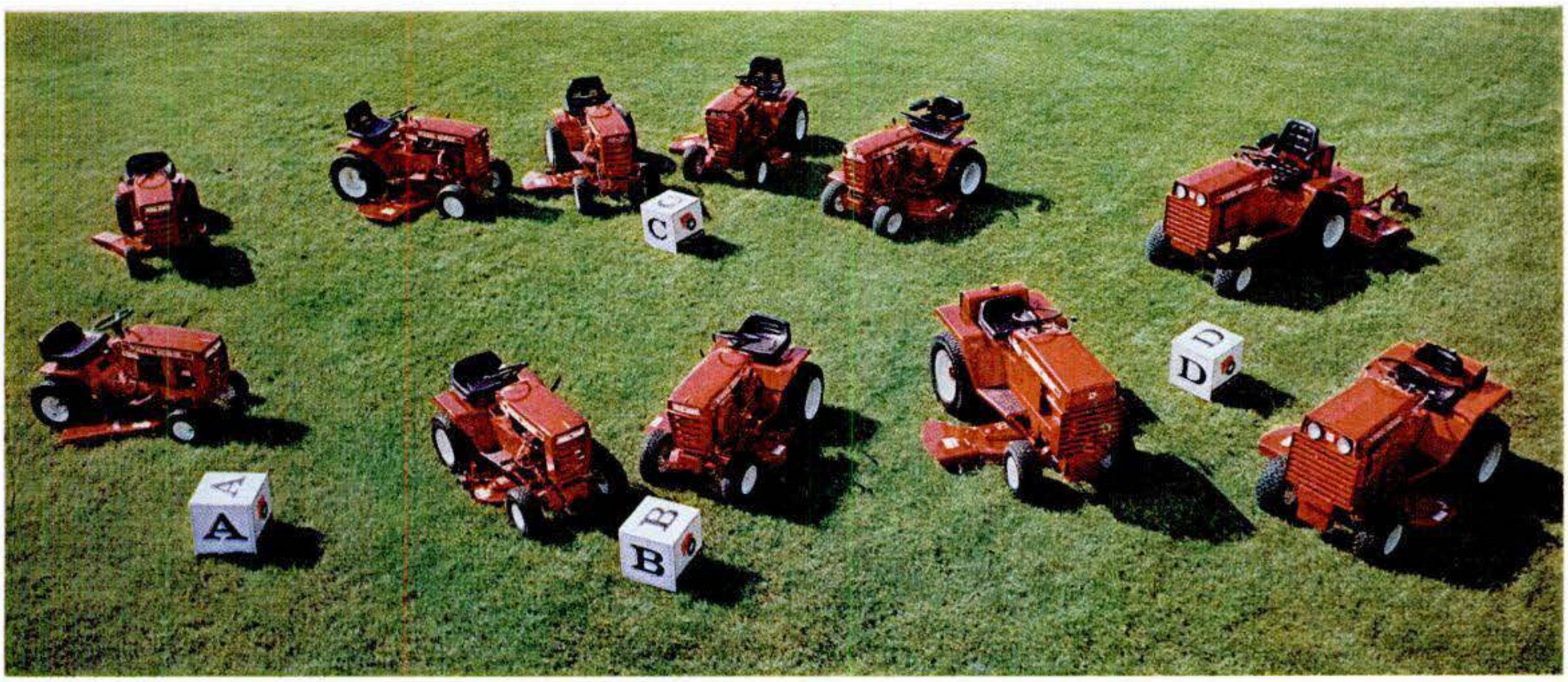
Introducing the 1974 ABCD's of tractoring... from WHEEL HORSE, of course!



...but why Four Series of lawn and garden tractors?

Simply because people have different size lawns. At the same time some people have gardens and some do not! So why buy more or less garden tractor than you really need? Wheel Horse has a tractor model tailored to your needs — no more — no less. We're confident you'll find the right lawn and garden tractor you really need among our eleven models—from 8 HP to 19.9 HP for 1974. That's why we build four series of lawn and garden tractors.

There's the economy line, the **A Series . . .** featuring the A-800 Ranger electric and the A-800 Ranger recoil lawn tractors for mowing small to medium-size lawns. A 32" mower is standard.

Then, there's the Wheel Horse compact **B Series,** including the B-80 4-speed and B-100 Automatic tractors. Both are value leaders and recommended for intermediate-size lawns and small gardens.

Our **C Series** tractors are designed for medium- or large-size lawns and gardens. A choice of four C Series models is available — the C-120 and C-160 Automatics and the C-100 and C-160 8-speeds.

The **D Series** tractors by Wheel Horse offer top-of-the-line features and horsepower. The D-200 Automatic is the biggest, toughest Wheel Horse tractor yet. It's powered with a 19.9 HP, twin-cylinder engine to provide plenty of smooth power for larger lawns and gardens. Two other D Series tractors are available . . . the D-180 and D-160 Automatics.

From the practical-economical viewpoint, it's better to buy the tractor that suits your needs. Your Wheel Horse dealer knows how to match the right tractor to the right job. So, we invite you to see your dealer today. He's listed in the Yellow Pages under "Lawn Mowers."

Write for your free 1974 ABCD's of Tractoring catalog. And kids, get your free "Get a Horse" decals. Just send a self-addressed, stamped envelope today!

Wheel-Horse Products, Inc.
Department PS1
515 W. Ireland Road
South Bend, Indiana 46614

WHEEL HORSE
lawn & garden tractors

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SOLID FORD

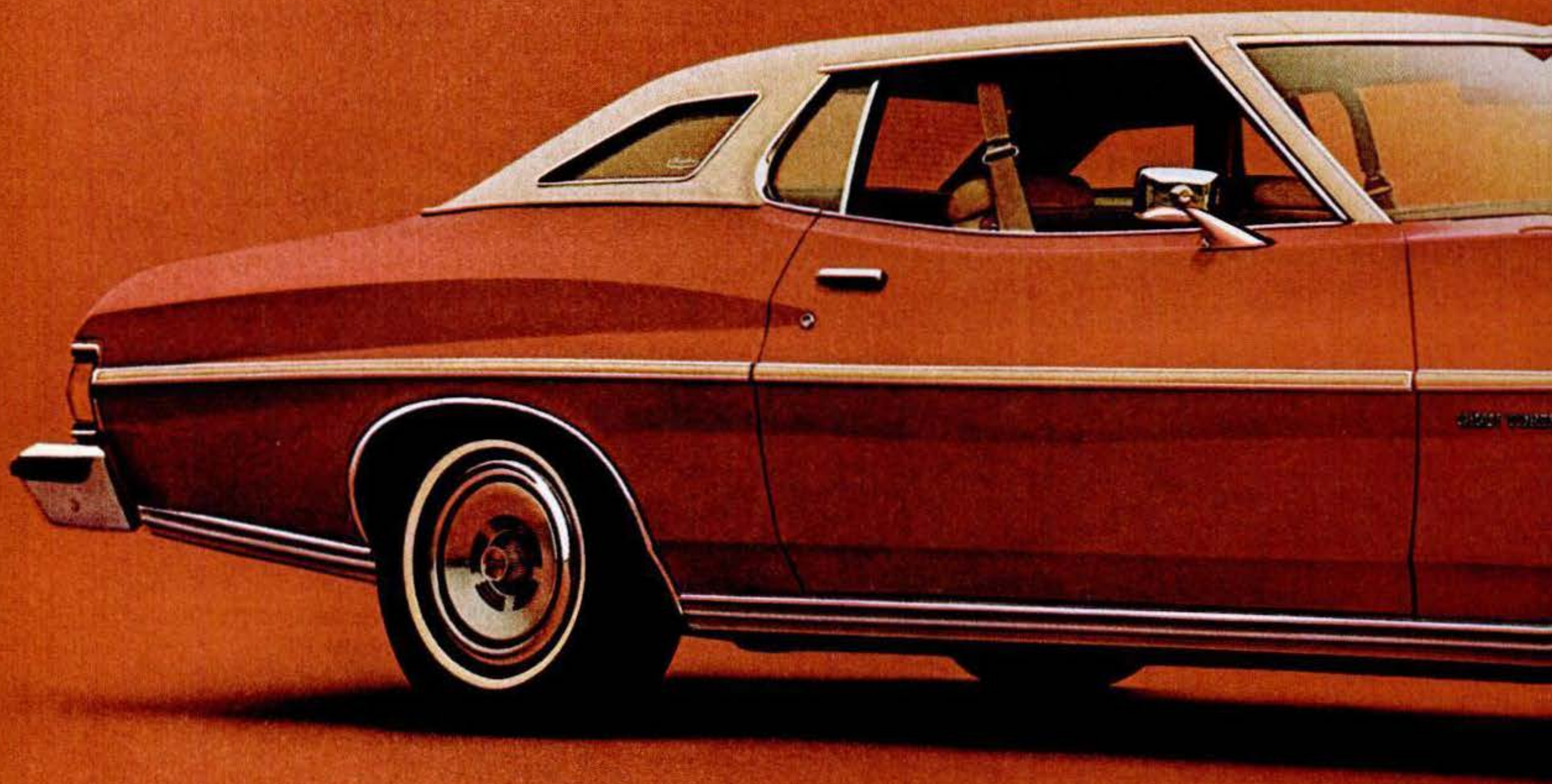
With a new young look and a smooth and steady ride.

There's more excitement than ever in the solid mid-size.

Outside, the Gran Torino's been restyled, with a gleaming new front end, a new rear end design and even an optional opera window. (Standard on Gran Torino Brougham.)

Inside, the Gran Torino Brougham's split bench seats (seen here) add a touch of luxury and convenience.

And while you can love Torino for its looks, you can trust it because it's solid. Torino's sus-



1974 Gran Torino Brougham shown with optional deluxe bumper group, electric rear window defroster and convenience group.

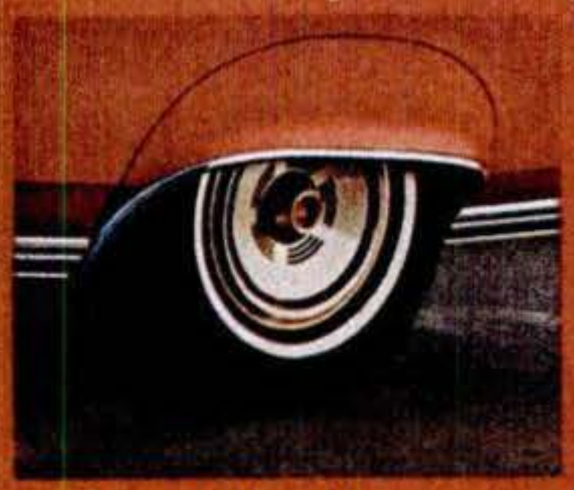
TORINO'74

pension, wide track and long wheelbase help give it a smooth and steady ride that spells quiet comfort and confidence on the road. As do Torino's steel-belted radial ply tires and power front disc brakes. (If you want them.)

In fact, safety and security are part and parcel of Torino's design. And this year, Torino's Lifeguard-Design Safety Features include a new style interlock safety belt system that lets you really move in your seat with ease and comfort.

See the complete Torino line at your Ford Dealers.

The closer you look, the better we look.

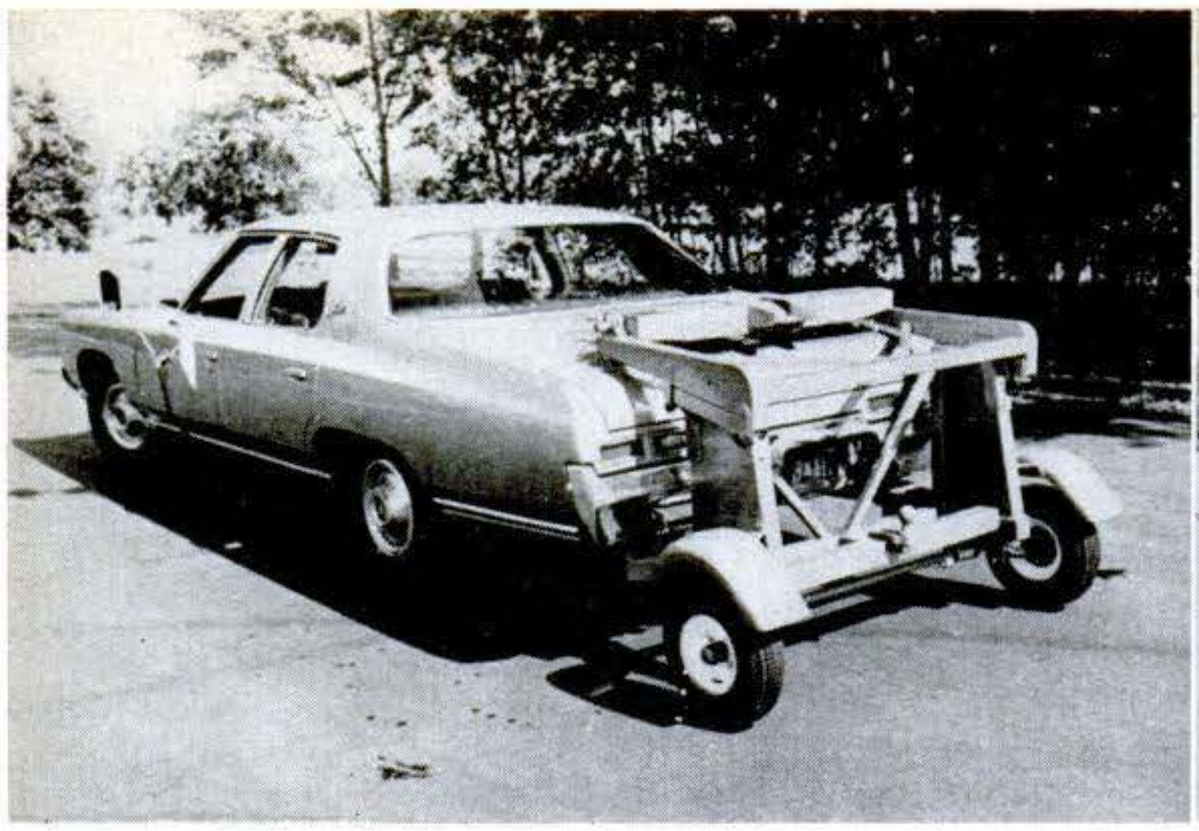


New optional fender skirts, power operated sun roof.

The solid mid-size.

FORD TORINO

FORD DIVISION



Now: A real fifth-wheel hitch for your car

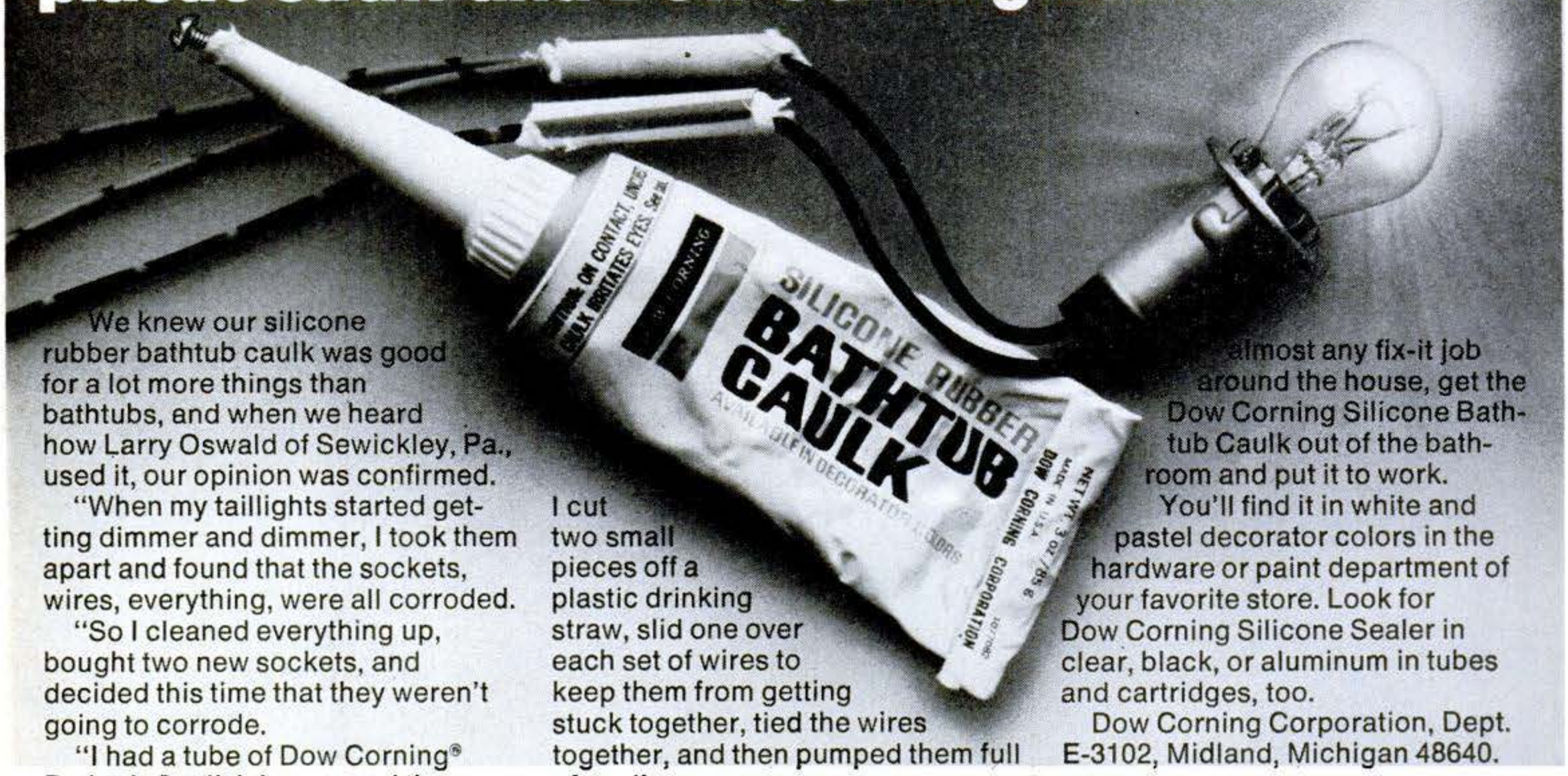
Hitch up a fifth-wheel trailer to your car? With a new adapter rig, you can. The Ace fifth-wheel hitch adapter attaches to the car frame without need for welding. Actually, you hook up your trailer to a dolly (above, left) with a fifth-wheel hitch. You get the advantages of fifth-wheel trailering without owning a pickup truck.

Fifth-wheel hitches are easier to hook up, make for easier maneuvering than ordinary hitches. They also pull a trailer without the sway you usually get with typical hitches.

Winter Welding and Machine Corp., 2580 W. Philadelphia St., York, Pa., maker of the Ace hitch, says it accepts all standard fifth-wheel trailers that use a 12- or 13-inch pin container. It has a hitch-weight limit of 1700 pounds and can haul trailers more than 30 feet long and up to 7000 pounds GVW.

The adapter could be especially handy for big families. Standard pickups carry a maximum of three passengers. You can carry six or more persons in your car. Suggested price of the Ace adapter rig is $545 f.o.b. It's available for standard and intermediate cars. Models for cars earlier than 1969 can be had by special order at additional cost. PS

"How I rewired my taillights with a plastic straw and Dow Corning Bathtub Caulk."



We knew our silicone rubber bathtub caulk was good for a lot more things than bathtubs, and when we heard how Larry Oswald of Sewickley, Pa., used it, our opinion was confirmed.

"When my taillights started getting dimmer and dimmer, I took them apart and found that the sockets, wires, everything, were all corroded.

"So I cleaned everything up, bought two new sockets, and decided this time that they weren't going to corrode.

"I had a tube of Dow Corning® **Bathtub Caulk lying around the house, so I figured why not, and caulked up the sockets.**

"Then I figured that if it'd work on the sockets, it'd work on the splices. I cut two small pieces off a plastic drinking straw, slid one over each set of wires to keep them from getting stuck together, tied the wires together, and then pumped them full **of caulk.**

"It's been six months now, and my taillights are still brighter than ever."

Next time you're faced with a plumbing leak, broken gasket, or almost any fix-it job around the house, get the Dow Corning Silicone Bathtub Caulk out of the bathroom and put it to work.

You'll find it in white and pastel decorator colors in the hardware or paint department of your favorite store. Look for Dow Corning Silicone Sealer in clear, black, or aluminum in tubes and cartridges, too.

Dow Corning Corporation, Dept. E-3102, Midland, Michigan 48640.

DOW CORNING

DOW CORNING

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Who knows what power lurks in the Copper Hearts of NGK's?

Thousands of bike and car enthusiasts know. Buggy, boat and snowmobile people, too. Plus do-it-yourselfers with chain saws, lawn mowers. But how is all that power packaged?

Open up an NGK. You see high alumina ceramics. The ribs, gaskets and nickel alloy tip —all sorts of strange things.

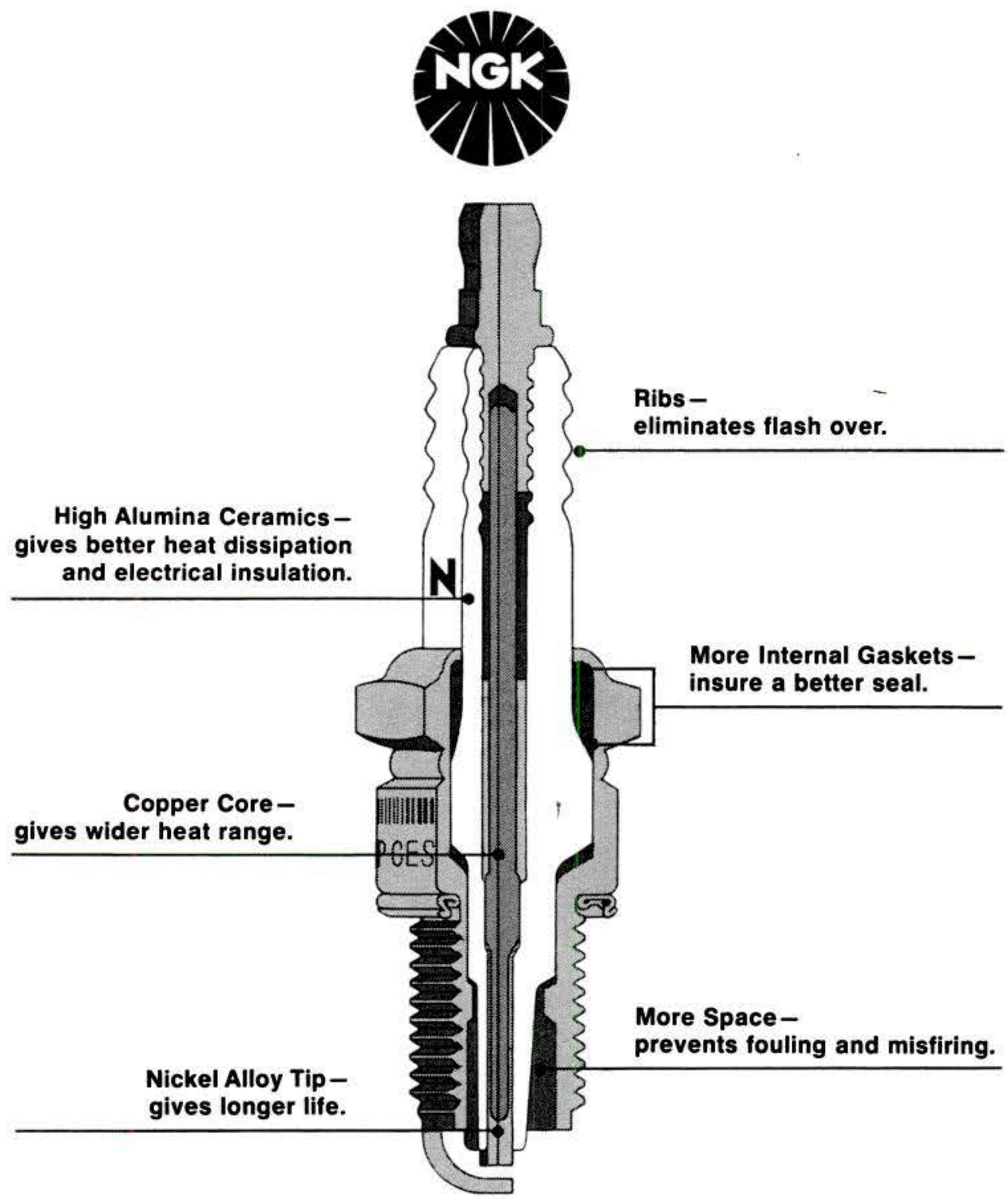
What you notice most—our "Heart of Copper." This copper core dissipates heat faster than ordinary iron cores. So there's less problem with plug-damaging hot spots on the electrode. Less chance for piston-popping pre-ignition. And a long-nosed insulator holds just the right amount of heat to reduce tip fouling.

The result—wider heat range plugs. They have the thermal flexibility to perform in hot or cold engines. Under easy or hard use, in two and four cycle engines.

Bike riders who only have one or two plugs love 'em. They fire on time, every time. Sports car and small car drivers know they can take the high revs. And they're happy in high compression-high octane, or low compression-low octane V-8's.

So NGK's have the guts to go the limit longer. Plug in a set. See how technical advances pay off in power. In lower fuel and maintenance costs. NGK's cost no more. They just do more.

NGK, the long life, hi-performance plug.



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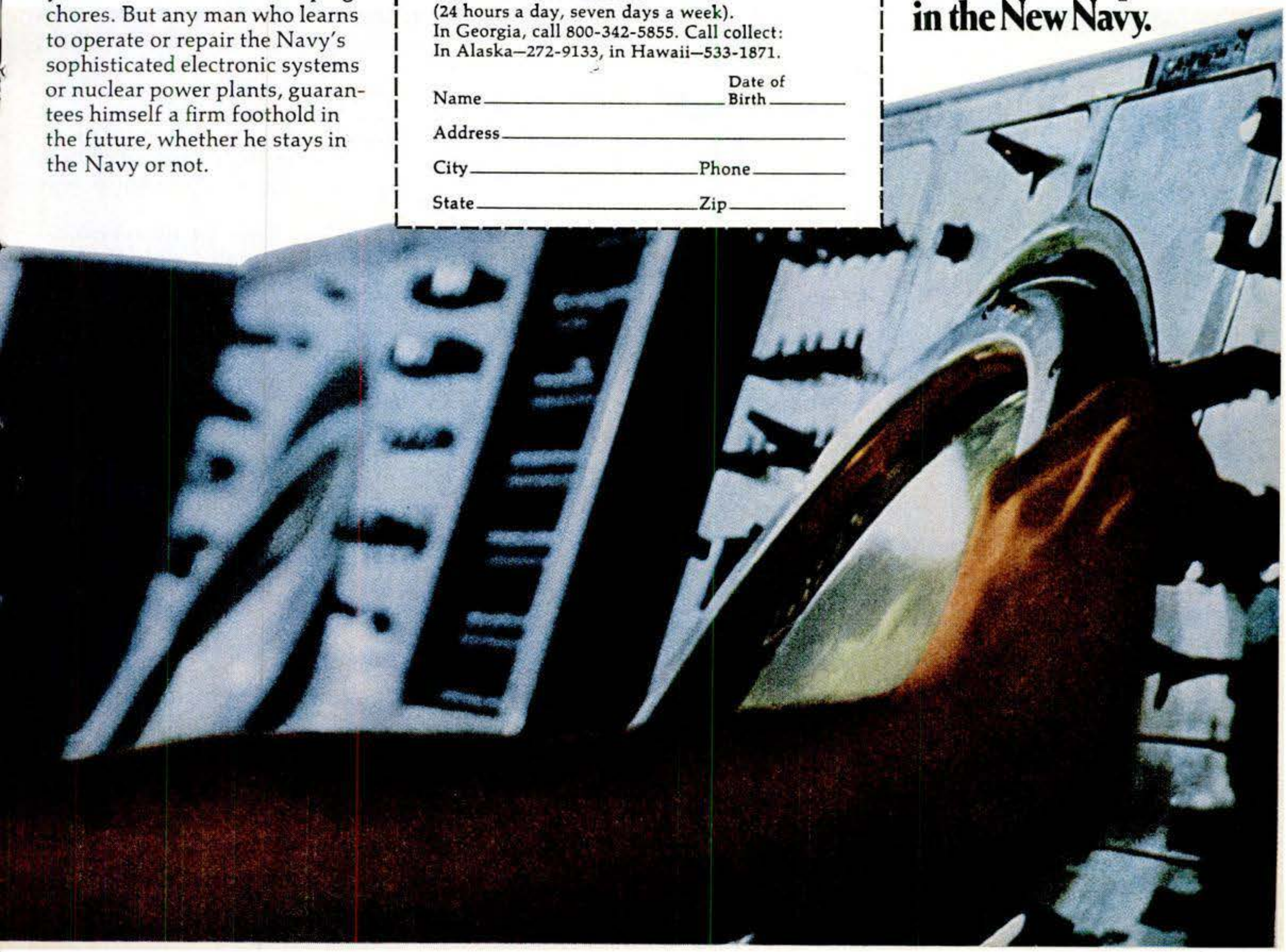

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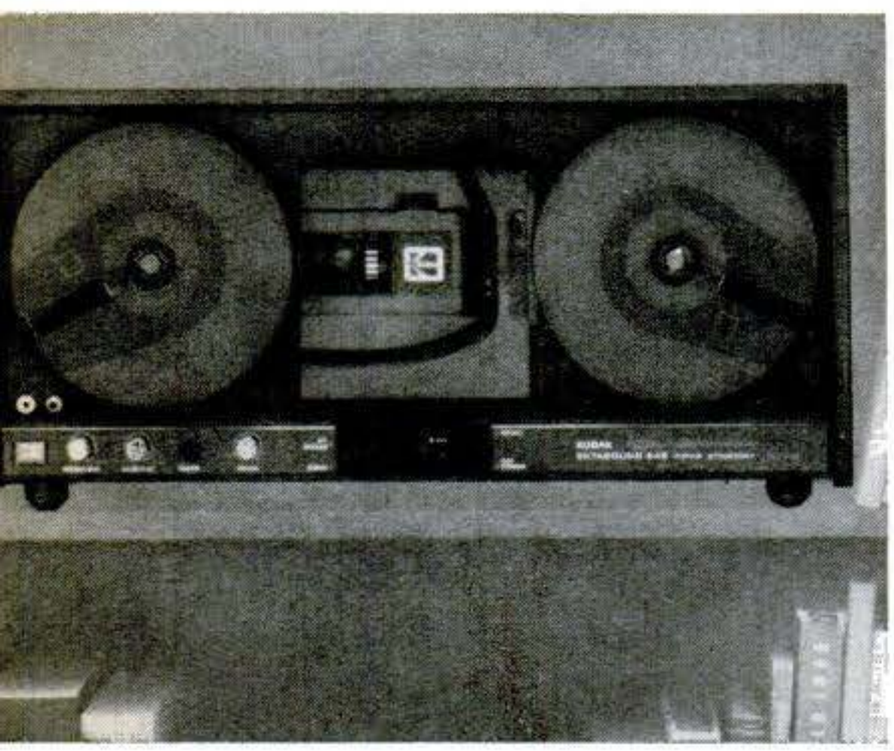
This Home Movie Camera Is a Sound Recorder, Too

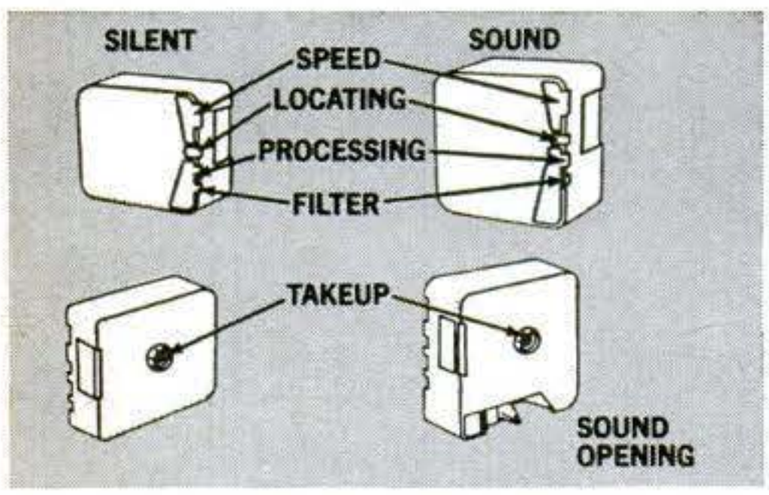
At last, Kodak puts it all together: a sound cartridge, camera, and projector

By EVERETT H. ORTNER
Group Editor, Consumer Information

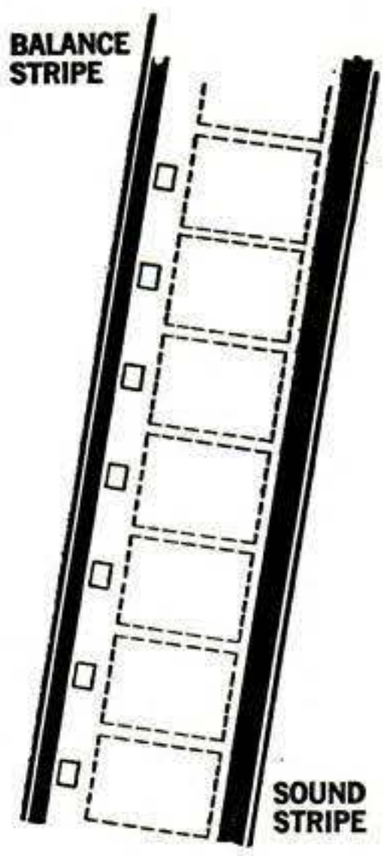


Ektasound camera, with sound system built in, has f/1.2 lens, CdS automatic exposure control. It can shoot either sound or silent super 8 film.

Ektasound projector plays 'em back. Model shown (245) can record or add sound on sound. It can put sound on old super 8 movies after striping.



Sound cartridge is 0.6 inch higher than silent, leaving room below film chamber for sound-head opening. Silent cartridge works in camera, but does not trigger sound mechanism, and thus runs at 24 frames per second instead of 18. Cartridge notches are unchanged. Balance strip helps film run easily.

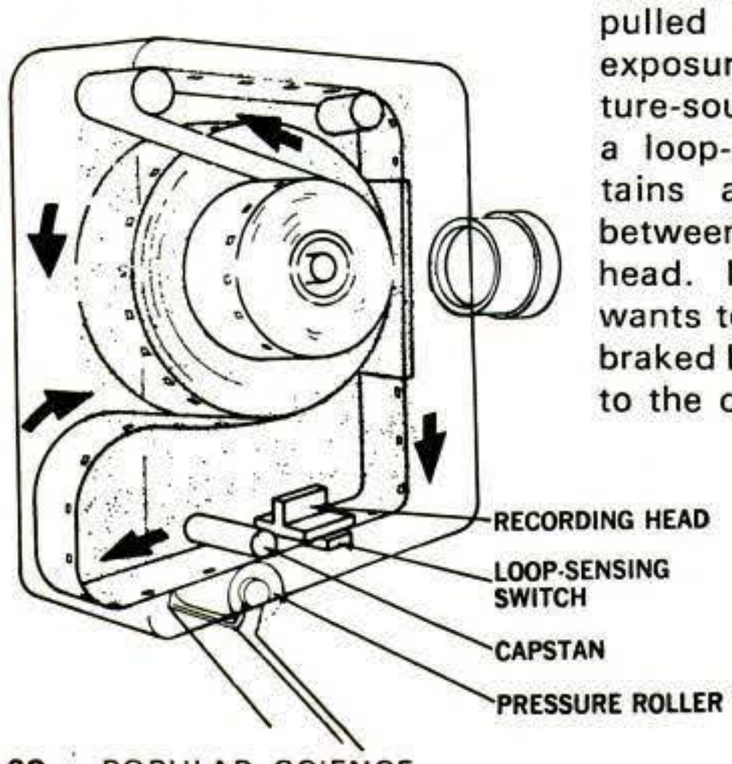


Plug the microphone into Kodak's new movie camera, and you're all set to take home movies with sound. No separate recorders, no cassettes, no fuss—it's the first super 8 camera with the sound recorder *inside.*

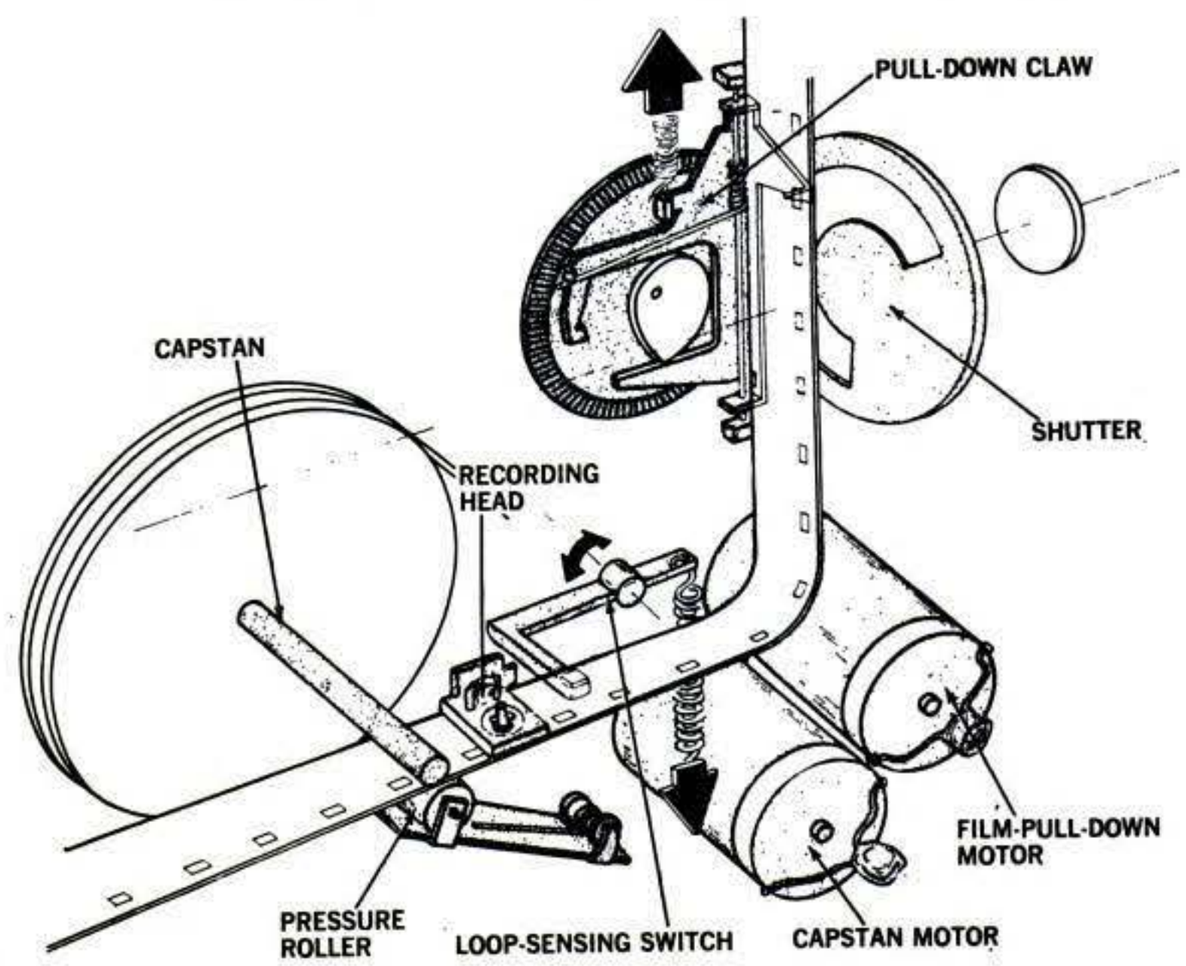
The technology is not all that new. Kodak has enlarged the body of an XL (available light) camera to accept a sound recorder. And they've put a magnetic sound stripe on the film. Nothing exciting. But only a camera maker who also makes film—and possibly only Kodak—could have put this package together, because the whole system rests on the cartridge: longer than the silent super 8 cartridge, with a cutout into which the camera's sound head fits, and offering much the same drop-in loading as the silent cartridge. But it is a *systems* cartridge; and just as Kodak has built its camera around it, so, undoubtedly, will other makers build cameras for it.

The sound-striped film, either Kodachrome II for sunny days outdoors or Ektachrome 160 for indoor home scenes without movie lights, enables you to record sounds and light simultaneously—and edit both simultaneously, splicing or editing with the same ease as silent film.

The new Ektasound cameras come in two versions: model 130 at $189.50 and model 140 (with 9–21mm zoom lens) at $274.50. To match the cameras are two handsomely designed sound projectors, only 6¼ inches deep and 10 inches high, styled to fit your bookshelf. These go for $219.50 (model 235) and $279.50 (model 245, with record and sound-on-sound capability). PS



Inside cartridge, film is pulled down past lens, for exposure, by claw. For picture-sound synchronization, a loop-sensing switch maintains an 18-frame interval between lens and sound head. Film-pull-down motor wants to run at 24 fps, but is braked by loop-sensing switch to the capstan's 18.



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Have one of mine.

Get hold of honest taste.

Have an Old Gold.

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

Valuable Gift Stars Coupons, too.

20 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report Feb. '73.

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The first aid kit's by Johnson & Johnson. Perfect for your car, home, place of work! It's a $3.95 value.

And the SUPER SWITCH control? It's GE's new mercury switch. Completely silent. With standard or lighted handles, for single or two-switch circuits. Easy to install.

And so durable, GE will mail you a free replacement if any SUPER SWITCH fails for any reason, in normal home use, within 50 years.

To get that $3.95 J&J first aid kit for only $2, send the front of one SUPER SWITCH package — and your $2 check or money order (no stamps), payable to General Electric Super Switch — to GENERAL ELECTRIC, P.O. BOX 6333, CHICAGO, ILL. 60677.

Please allow 4-6 weeks for delivery.
Offer ends June 30, 1974.

GENERAL ELECTRIC

Sun 'n' Snow Tire.

The Seiberling Four Seasons, the original asymmetric snow tire. Powers through snow, hugs slippery surfaces. Yet runs like a whisper on dry pavement. As good a tire in summer as in winter. Drive in to your Seiberling dealer now, and drive out on a better road. Call toll-free for your nearest Seiberling dealer: **800-447-4700.** (Illinois residents call 800-322-4400.)

NFL HAT $1.99

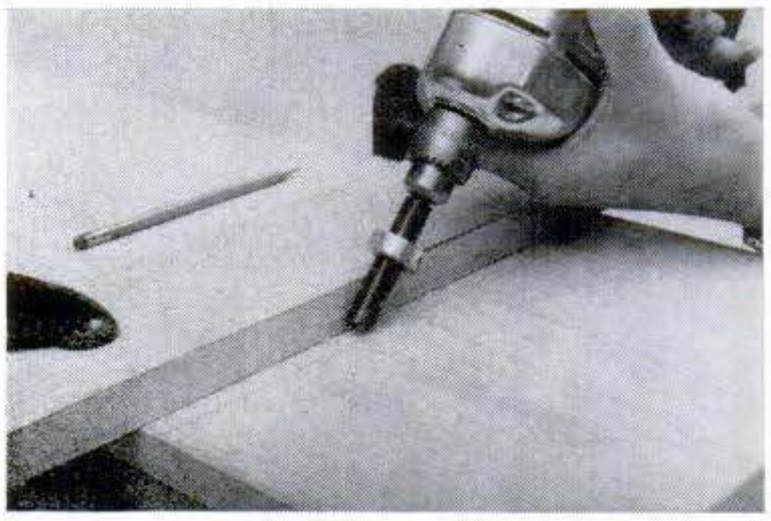
For a limited time, your Seiberling dealer is offering an official NFL Action Hat—a washable, warm acrylic knit stocking cap. Official team colors and team insignias. Only $1.99.

Seiberling. The Better Road.

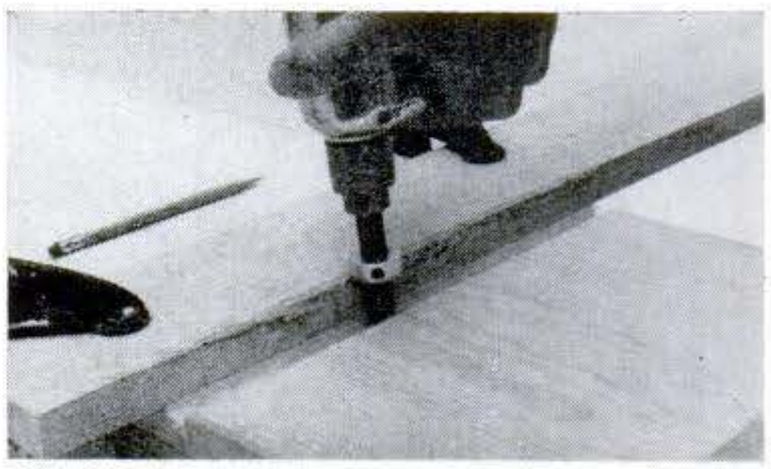
Knife-edge spurs and chisels form Electrichisel's cutting team. Setscrew-adjusted ring controls depth of cut.

Now—Dadoes and Rabbets with Your Electric Drill

If you want to upgrade your joinery a step or two from simple butts, but lack the power tools to do it the easy way—or the chisel skills to do it the hard way—try Stanley's new Electrichisel. It chucks in your electric drill to cut dadoes, rabbets, mortises. Two sizes—½" and ¾"— make cuts just the right width for plywood and nominal 1" lumber. Multiple passes will give you even wider cuts. About $5-$6.—*A. J. Hand*



Dado is started with tool held at 45-degree angle. Hardwood strip clamped to the work assures a straight cut.



Cut is finished with tool held vertically. This ½"-by-½" dado across a pine 1-by-12 took PS Shop Editor six minutes.

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IF YOU HATE SHOVELING SNOW FOR HOURS...

HERE'S HOW TO HATE IT FOR ONLY MINUTES!

The Ariens Sno-Thro! When winter's at its worst, this rugged, powerful SNO-THRO will muscle its way through the heaviest snowfalls and knee-deep drifts with ease. Frankly, it makes snow removal almost fun.

Easy to maneuver, the Ariens Sno-Thro has four speeds forward and reverse. Cuts a clean swath with its two-stage, self propelled action. The 240° swing around discharge chute throws the snow up to thirty feet. Waist high, finger-tip controls ensure quick response. Available in 4 HP, 5 HP, two 6 HP and two 8 HP models with auger widths from 20" to 32" to suit your needs.

Why not join the thousands of discriminating owners who have made Ariens the industry's biggest seller. Check the Yellow Pages for your nearest Ariens dealer.

Ariens

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EMPEROR GRANDFATHER CLOCK

DO-IT-YOURSELF CASE KIT

MODEL 120 IN SOLID 3/4 INCH CHERRY

SALE PRICED 89.50

REGULARLY $129.50

Finished Model 120 in cherry shown

All pieces pre-cut and pre-sanded at the factory. Breakfront swan neck crown and finial, waist and dial doors, dial frame and sculptured base-front factory assembled by skilled cabinetmakers. Complete hardware and assembly instructions furnished. Each piece may be re-ordered separately. No woodworking experience necessary.

NOW A FIRST FROM EMPEROR

FOR THE VERY FIRST TIME . . . IN CHERRY

Since colonial days cabinetmakers and woodworkers have chosen cherry for its distinctive natural color and beautiful, close grain. Now you can share in this American heritage of craftsmanship. Emperor's stately Model 120 (America's most popular grandfather clock) is now available in lustrous cherry. The rich look and resonant quality of this fine hardwood enhances the desirability of this elegant timepiece. Build it yourself, and enjoy that rare feeling of self-accomplishment that comes from one's own workmanship. The Model 120 Do-It-Yourself Case Kit is easy to assemble, and contains everything you need except the movement (ordered separately from Emperor).

ENJOY DOUBLE SAVINGS

You save on this beautiful cherry grandfather clock because you build it yourself. And you save even more now, because the Model 120 solid cherry case kit is sale priced at just **$89.50**. Save $40.00 from the regular price of $129.50. Install the movement and save hundreds from the price of comparable grandfather clocks retailing up to $600. There is no better reason to order this beautiful clock now, adding "the final touch of elegance" to your home, while creating an heirloom for generations to come.

MONEY BACK GUARANTEE
If not completely satisfied, return in original shipping carton within thirty days for complete refund. No questions, no excuses.

ORDER NOW . . . IN TIME FOR CHRISTMAS— Emperor Grandfather Clocks are a pleasure to give . . . a joy to receive. By ordering now, your kit will arrive in time to build for yuletide enjoyment.

Model 120, Solid 3/4" Cherry
74"x16 3/4"x10"

SEND FOR FREE COLOR BROCHURE OF COMPLETE EMPEROR LINE

OFFER GOOD THROUGH DEC. 31, 1973

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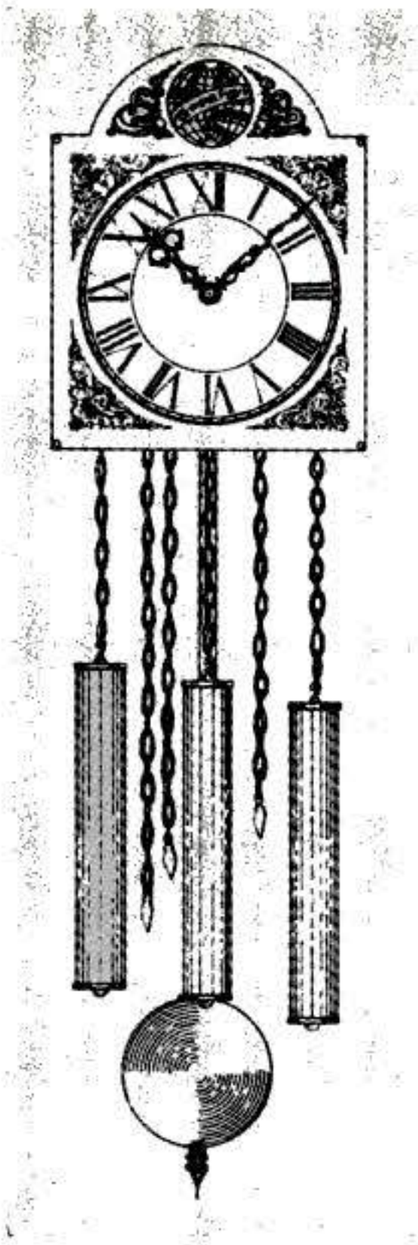


100-M Movement with Tempus Fugit Dial
$89.50

EMPEROR MOVEMENT FOR MODEL 120

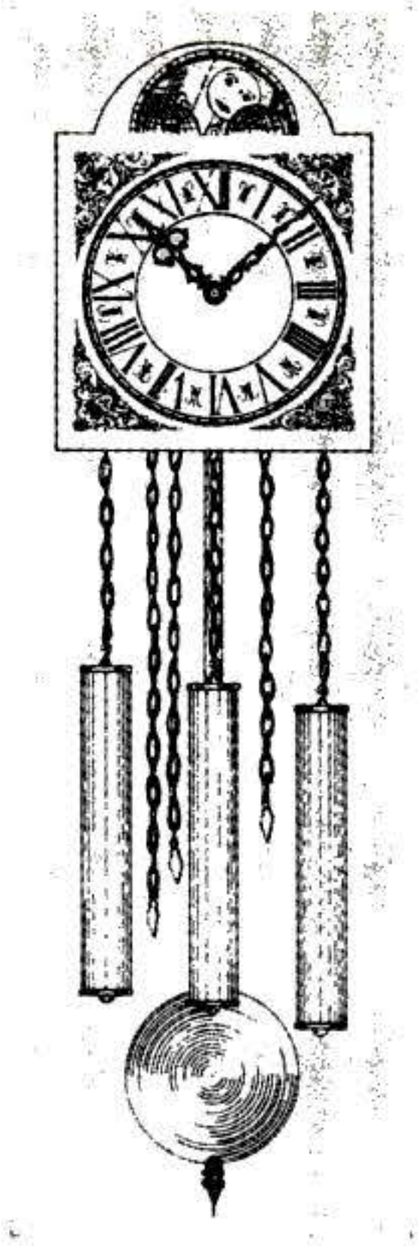
WEIGHT-DRIVEN—EIGHT-DAY—WESTMINISTER CHIMES

Emperor's 100-M grandfather clock movement is produced in West Germany by proud clocksmiths who, for over a century, have been manufacturing the world's finest movements.

Embossed overlays surround the solid brass dial. The face has a high, permanent polish and serpentine hands. In the arch above the dial is a shaped aluminum world with the words "Tempus Fugit" (Time Flies) inscribed in black enamel. Or, if you prefer, the classic moving moon with lunar calendar.

The completely weight-driven movement strikes the famous, melodious Westminister chimes on four musically-tuned rods; four notes on the quarter-hour, eight on the half-hour, twelve on the three-quarter hour, and sixteen on the hour. The hour is struck on four additional tuned rods. The Emperor movement includes weights, solid brass weight shells, brass bob, pendulum and chimes. All plates are solid brass, and pinions are hardened steel. Installation and adjustment of the movement is simple, following the step-by-step instructions.

ONE YEAR UNCONDITIONAL GUARANTEE



100-M Movement with Moving Moon Dial
$99.50

MERRY CHERRY AT CHRISTMAS SAVINGS!

ORDER NOW!...DIRECT WITH THIS FORM!
OFFER GOOD THROUGH DEC. 31, 1973

CLOCKS, KITS, MOVEMENTS SHIPPED 2 TO 3 WEEKS, SHIPPING CHARGES COLLECT

WORLD'S LARGEST MANUFACTURER OF GRANDFATHER CLOCKS

TO: EMPEROR CLOCK COMPANY, Dept 55
Emperor Industrial Park, Fairhope, Alabama 36532

Please Check:
New Customer ☐
Previous Customer ☐

QUANTITY	DESCRIPTION	WEIGHT	REG. PRICE	SALE	EXTENSION
	Model 120-K Do-It-Yourself Case Kit, Cherry, w/o movement	53	$129.50	**$89.50**	
	Model 100-M movement complete with Tempus Fugit dial, Westminster Chimes for Model 120	32	$89.50		
	Model 100-M movement complete with moving moon dial, Westminster Chimes for Model 120	32	$99.50		

We accept personal checks.

ENCLOSED: ( ) CHECK ( ) MONEY ORDER $_____

CHARGE TO MY ( ) BANKAMERICARD ( ) MASTER CHARGE

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What the "ear bug" heard in 22 noise tests

Make	Model	Engine Displacement (cc)	Sound Pressure Level (dB-A) Full Throttle	Cruise	Slow Cruise
Harley-Davidson	Y-440	433	106	99	97
John Deere	JDX8	438	103	99	96
Suzuki	Yukon 400 WT	395	103	99	96
Yamaha	SL433 F	433	111	100	100
Evinrude	Trail Blazer 45RC	528	105	95	91
Johnson	JX650	646	105	101	97
Scorpion	Super Stinger 440	434	106	102	100
Sno-Jet	SST	433	108	101	101
Sno-Jet	Whisper Jet	433	103	101	100
Massey-Ferguson	Ski Whiz 440 WT	428	102	95	90
Mercury	440 MAX	438	108	104	99
Mercury	Hurricane Mark II	644	104	101	95
Northway	440 Interceptor	438	105	102	96
Ski-Doo	Elan SS 320	294	105	99	95
Ski-Doo	T'NT 440	436.5	106	104	95
Skiroule	RTX 447	438	102	94	92
Skiroule	RTW 300	293	102	101	95
Moto Ski	Grand Sport	436	104	99	96
Arctic Cat	Cheetah 440	436	106	102	92
Chaparral	Thunderbird 440	432	108	103	99
Raider	44 TT	436	103	99	93
Raider	Double Eagle	436	105	102	99

Tape recorder is hooked up to microphone by PS Associate Editor Ray Hill (left), who drove snowmobiles in tests. Prof. A. R. Howell, who conducted tests, adjusts recorder. Results are shown above. All machines meet 1974 82-dBA requirement from 50 feet away. But even the quietest snowmobile is twice as noisy at the driver's ear.

SNOWMOBILE NOISE

...PS puts a bug in the driver's ear

PS listens to snowmobiles with a new technique and finds them noisier when you're on top

By HERBERT SHULDINER

How noisy is a snowmobile? It depends on where you're standing—or sitting. Manufacturers can tell you what the noise level of their machines is from 50 feet away. That's the distance at which snowmobile noise is measured to meet requirements of various states that noise emissions be no higher than 82 dBA.

But what's the noise level *you* must cope with when you're driving one?

That's what POPULAR SCIENCE wanted to know. So, recently, we asked the Industrial Research Institute of the University of Windsor, Canada, to test a sampling of 1974 prototypes for "driver's ear" noise levels. Prof. A. R. Howell used a new "ear bug," developed by the National Research Council of Canada, to make the tests.

The "ear bug" is a tiny microphone that is taped to a driver's head so that it nests in the concha of his ear—in this case Associate Editor Ray Hill's ear.

Hill drove 22 models (listed in the chart above) at three throttle settings—full speed, cruise, and slow cruise. The noise he heard was recorded on a cassette recorder he wore, and then analyzed in the noise laboratories of the Institute. The results are shown in the chart.

How to cut noise. What is most apparent is that you can cut snowmobile noise significantly on most machines by throttling back to cruising speed—rather than racing flat out.

Are the noise levels we recorded harmful? We posed that question to A. J. Brammer, one of the scientists who perfected the ear bug. His reply: There hasn't been enough research to gauge the effects of snowmobile noise on the people who drive them. But the Walsh-Healey Act, which sets industrial noise limits in U.S. factories, says workers may not be exposed to more than 115 dBA for over 15 minutes a day. A half-hour per day is the limit for noise levels of 110 dBA, and an hour for 105 dBA.

Noise effects add up. You can certainly exceed these limits when driving a snowmobile for extended periods. And Brammer points out that snowmobilers who work in noisy places can receive more harm than those who work in relatively quiet spots. That's because noise effects are cumulative. So if you work in a factory or some other noisy spot, be warned.

Surprisingly, you can't really cut snowmobile noise by wearing a safety helmet. Tests by the Canadian National Research Council, says Brammer, show that helmets have no effect on noise. It takes ear plugs or muffs to give you adequate protection for your hearing. PS

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PS: What's News...

Keeping You Posted from Behind the Scenes

This month's cover showing Spectronic Corp.'s electronic Moneyscanner and a $10 bill is the result of three clicks of the camera shutter. Orlando Guerra took the photo of the machine, and A. J. Hand snapped two pictures, a real and phony (left half) ten. All three were assembled in the lab. To conform to Federal law, the bill is reproduced in black-and-white, one-and-a-half times normal size. It's illegal to reproduce money actual size or using accurate colors.

Reporter Doug Garr, who wrote the story, says the hardest part was tracking down a "real" phony bill for the picture. "I called the Secret Service," he said, "and asked to borrow a phony. They said, 'Sorry, we can't let any out—even to a magazine.' So I tried to swing a loan from one of my sources. He turned me down, too. Finally, I talked him into letting us photograph a counterfeit in his office.

"Later, I called the Secret Service again to ask what regulations we had to follow in illustrating a phony. I spoke to the same agent. He sounded somewhat annoyed, probably because there's no law about reproducing phony currency. Finally, he said, 'I guess the same rules apply.' So we treated the counterfeit half just like the real."

Garr also had trouble gathering information for his article. "Nobody wanted to talk very much," he said. "Cooper was afraid counterfeiters would find out how his machine works, and the Federal agents were worried that the counterfeiters would learn too much about real money.

"A few sources were eager to talk and told me everything they knew. But when I checked out the facts, they turned out to be wrong."

Nevertheless, Garr did manage to dig out some interesting information. His report begins on page 78.

Geothermal heats up

During the course of research for my article on geothermal power ["Hot New Prospects From the Earth," PS, Aug. '72], I visited a drilling site in the desert outside Yuma, Arizona, designated the East Mesa Anomaly. The hole that was being poked in the Earth at that time has turned out to be an important well. Aerojet General Corporation's Envirogenics Systems Company, under contract from the U. S. Department of Interior's Office of Saline Water and its Bureau of Reclamation, reports that the first significant amounts of pure water ever distilled from geothermal brine have been produced at that well. The first run produced 7000 gallons. Now regular production will begin experimentally.

One of the big promises of the geothermal field in the Imperial Valley is that the hot, salty water can be brought to the surface, and much of it flashed into steam. The steam can be used to drive a turbine and generate electricity, then condensed and used as pure water. The remaining brine is reinjected into the ground to prevent eventual subsidence of the area. Thus the deposit of salt water that underlies vast areas of southern California can become a double-barreled resource, yielding both electric power and water.

Energy conservation gaining momentum

While it's clear that we will have to develop all possible new sources of energy to keep up with the growing need in coming years, it's just as clear that we also have to be a lot more careful in our use of energy than we have been in the past. That message seems to be beginning to get through. Some examples:

- Montgomery Ward has launched a promotional campaign to promote efficient appliances. The company has put special tags on particularly efficient air conditioners and is pushing the use of microwave ovens, pointing out that they use only one-fourth the normal amount of energy to cook a given amount of food.
- Magnavox is pointing out that 100-percent solid-state TV chassis use 15 percent less electricity than hybrid sets.
- And I even saw a TV commercial recently in which one firm claims that its refrigerator uses less electricity than competing makes.

Obviously these companies want to sell their equipment. They must think somebody out there is going to be impressed by the energy-conservation argument. That's a good sign.

Is there a Ford CVCC in your future?

The Honda CVCC stratified-charge automobile engine that was the subject of our April cover has been receiving a tremendous amount of publicity because Honda claims it can meet most of the tough Federal pollution standards (with the possible exception of the oxides of nitrogen standards). And it does so by improving combustion rather than with costly catalytic converters that try to solve the problem after the mess has been made. Latest news is that Ford has purchased nonexclusive world-wide rights to develop, build, and sell the Honda engine. That doesn't mean Ford is going into production; the big auto maker simply wants to be in a position to run if the wind seems to blow from that direction. Both General Motors and Chrysler are also talking to Honda.

More on the turbine

Last month's cover story concerned the new gas turbine car Chrysler is building in cooperation with the Environmental Protection Agency. Automotive editors Norbye and Dunne were very favorably impressed by the work done so far and wrote that the turbine has about as good a chance as anything now in sight of being the winner in the low-emission-engine sweepstakes.

Interest is certainly growing. EPA has now announced that NASA, which was already doing some work on the internal aerodynamics and other aspects of the turbine engine, is now being put to work on a three-year project to develop turbine technology and actually demonstrate a turbine-powered car that meets or betters the 1976 Federal emission standards, delivers good fuel economy, and performs well.

C P Gilmore

Executive Editor

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Counterfeit Money Detectors: Do They Really Work?

Bogus bills are proliferating — production was up 18 percent last year. But a new electronic detector may help cut that number

By DOUG GARR

Spectronics' Moneyscanner 1250 checks a suspect bill for authenticity. Negative meter and sonic response indicate a counterfeit. Positive response requires another test ("prove" scan). Yellow zone is questionable.

Bill Cooper slips a $10 bill into a transparent carrier, places it under two hold-down clips with Alexander Hamilton face up, and flips a switch on the machine. The bill oscillates under a scan head. Simultaneously, there's a sound—almost like a "boioioioinng"—and the needle on the meter jumps into the plus zone.

"It's genuine," says Cooper.

I'm watching a demonstration of an electronic counterfeit-money detecting machine, a $450 metal box that looks as ordinary as a battery tester. It *is* simple on the outside; a couple of indicator lights, a switch, a button, and a display gauge. But inside resides a sophisticated machine. It can tell, with a high degree of reliability, the difference between real and bogus Federal Reserve notes of any denomination up to $100 bills and as old as 1934.

Big deal. So the box says his $10 bill is real. I don't need a machine to tell me that. I want to see this thing tell me a phony is a *real* phony.

Cooper senses my disappointment. But there's nothing he can do. He couldn't show how the machine detects a counterfeit note because the Secret Service won't let him keep any bogus currency around.

To make up, he shows another trick. He takes out another $10 bill with "contesado" (Spanish for counterfeit) stamped on the front. He puts it in the machine. The needle jumps, and the machine boings. The note is genuine. Genuine? Because it was old and worn, it had fooled a foreign teller. I believe the machine, not the teller. We examined the bill under a magnifying glass, and I saw the tiny red and blue silk fibers woven into the paper that are characteristic of real money.

Bill Cooper is a tall, slightly graying businessman and sometime inventor. He is president of Spectronics Corp., a Long Island, N.Y.-based firm that makes bank equipment in addition to counterfeit-money detectors.

Not everyone is as enthusiastic as he is about the machine—called the Moneyscanner 1250—featured on this month's cover. The U.S. Secret Service tests counterfeit-money detectors (and they probably tested Cooper's), but their official position has been steadfastly pessimistic. "We do not endorse or recommend the use of counterfeit-note detectors," says an agent. "To date, a detector that is 100-percent accurate has not come to our attention."

Machine vs. the experts. True, it's not perfect. Even Cooper admits his electronic scanner isn't foolproof, even though it's never been beaten. But is the machine as good as the world's best money-handlers—cashiers, bank tellers, Federal Reserve Bank counters?

I talked with more than 15 leading counterfeiting and currency authorities to find out. After careful investigation, I learned it's more accurate than many tellers, but not as good as others. At the New York Federal Reserve Bank, where over $50 million in cash

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Counterfeits are examined under ultraviolet scanner by Off-Track Betting Corp.'s Steve Vorillas (left) and author.

Marking up $1 bill to a ten is crude form of counterfeiting, but it often works. Markups feel thicker on ends, for the numerals are pasted on.

$10 bill (which appears on cover) contrasts phony left half and genuine right half. Inferior printing at left is revealed on serial number, lettering.

$100 bill is fairly good copy of real thing. Note print fading on center crease through Franklin's portrait.

Lab technician prepares large copy of counterfeit for evidence in Federal Court. Phonies are carefully analyzed.

i is handled daily, the counters visually detect nearly 70 phonies a day (mostly $10s and $20s). Those 70 are notes accepted as genuine by member banks' tellers. On the other hand, a sharp teller may catch a phony the machine may miss.

The need for automated detectors is obvious. During 1972, the Secret Service confiscated some $27.7 million in bogus currency—a record. Luckily, 83 percent was grabbed before circulation, and only $4.8 million is listed as "losses to the public." There's no way of telling how much gets passed undetected, since counterfeiters don't publish annual reports. Says one source: "I think the Secret Service figures are only the tip of the iceberg."

Continued

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How the Feds make our money hard to copy

There are illegal and cheap copies of everything, and our money is no different. Michael Plant of the Bureau of Engraving and Printing sums up their philosophy on counterfeiting: "We know it's not impossible to duplicate our currency. We just try to make it as difficult as possible."

To find out just how hard it is to copy the real stuff, I toured the Bureau's money-making plant in Washington, D.C. As you might expect, Uncle Sam's operation is far more elaborate than the average printer's.

After I was cleared through security, my guide took me to the printing room. Steam jets around the room control humidity so the ink can dry properly. Four huge printing presses rumbled. They were printing $1's that day. As I climbed on the scaffold of the presses, I heard the incredible statistics: 7000 sheets per hour at 32 bills per sheet. The presses roll 24 hours. That's 672,000 bills per day from one press. The money goes through the presses three times—once each for the front and back, and a third time, called "overprinting," for serial numbers and the Treasury Dept. seal (the light green ink on the face).

"Want to see the plates?" asked the supervisor. Yessirree. Finally, I got to touch the plates that made Hollywood history for getting into the wrong hands. Each plate has 32 reverse cuts of bills. That's where the Bureau takes the trouble for printing excellence. The lines are etched deeply to hold more ink where there are dark spots, and shallow for light spots. The incised process—called intaglio—gives fine, closely detailed results ("depth, or a 3-D look," as the Bureau likes to say). It is hard to copy sharply with the average printer's offset press.

New engravings are continually being made. Making a bill requires meticulous detail and lots of time, so several engravers work on different sections. One may do the portrait, another the lettering, etc. A geometric lathe spins the fine spirals on the borders.

When each section is okayed, it goes to the siderographers for assembly. The original engravings are actual-size reverse image. The siderographer transfers the original to a roll cylinder (image now positive) with a special press. The cylinder transfers the bill's image to the plates 32 times, one at a time in a four-by-eight matrix. The plates have a reverse image, and of course, the final printing is positive.

Dozens of checkers examine the sheets for errors. Finally, stacks of individual notes are cut out and packed in bundles. Now they're ready to be sent to Federal Reserve banks.

The reason figures are up is simple: More and more counterfeiters think they can do as good a job as Uncle Sam. Offset printing and high-speed presses allow printers to turn out reasonably good imitations: certainly good enough to pass at the supermarket, probably good enough to pass at the racetrack, and sometimes good enough to get by a bank teller.

Quality of the bogus notes varies greatly from miserable ("like they were printed on toilet paper," says one source) to excellent. I saw one phony at the Bureau of Engraving and Printing that was printed with the same intaglio process the government uses. The bill looked perfect. The Bureau technician said it was one of the best he'd ever seen. But the paper was a dead giveaway. It contained traces of what Bureau lab experts call "optical brighteners"—organic white dyes used to make paper look whiter.

And these brighteners (Cooper calls the stuff "optical bleach") are where mechanical counterfeit detection began in the mid-1960's.

Government stock is an expensive blend of rag bond, 75-percent cotton, and 25-percent linen. It doesn't have any wood pulp, the heart of most ordinary paper, and it doesn't have any brighteners. Currency paper is really a sort of off-white. Only Crane and Co. of Dalton, Mass., is authorized to make the paper for Federal Reserve Notes. (It is illegal to make even the *paper* our money is printed on.)

Telltale glow. After checking thousands of phonies in 1965, Bill Cooper discovered that many counterfeits glowed a peculiar blue-white (the brighteners) under properly filtered ultraviolet light. This glow—something like the white glow in a Day-Glo poster under black light—led to the development of the first generation of detectors: ultraviolet (UV) scanners. They basically allow the user to view currency under UV light between 3200–4000 angstroms. Since real money doesn't glow, bills that do are bogus.

Simple. Until Bill Cooper accidentally left a genuine $5 bill in his shirt pocket. His wife washed it with the rest of the laundry. Curiously, he shoved it under a scanner. It glowed. Brightness picked up from the detergent made it look like a phony.

So UV isn't entirely reliable. Accidentally wash your money, and someone with a scanner may accuse you of trying to pass a phony. But there's a more fundamental problem: Some counterfeit bills don't glow.

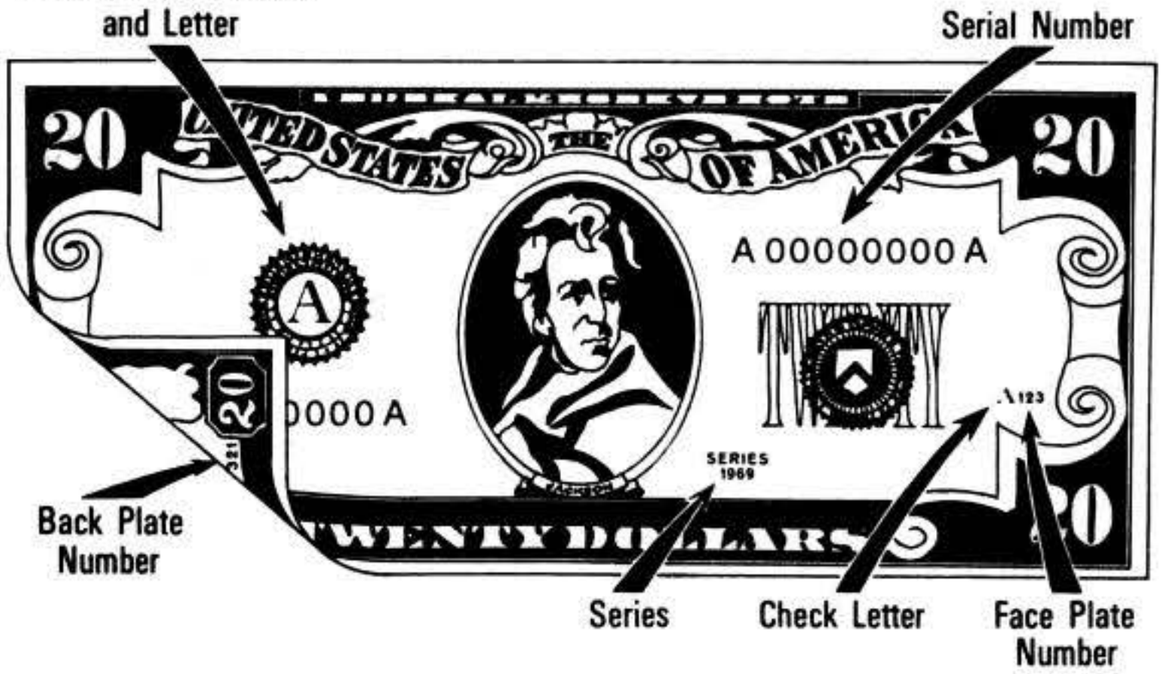
Cooper says that "many to most" of the counterfeits will exhibit chromamorphic response—they'll glow under ultraviolet light.

Everyone has his own guess when it comes to the actual figures. L. B. Tucker, technical director of Crane and Co., says a "good share" of the bogus contain this whitening agent. Steven Vorillas, assistant director of security at New York City's Off-Track Betting Corp. (which uses Spectronics equipment), says "only a few" phonies show up under UV scanners. One executive at First National City, the world's second largest bank, contends about "half the notes won't be detected" under UV scan.

Further, counterfeiters now may be able to get paper made without brighteners. "There's good paper, rag stock that doesn't glow, coming in from Cuba," one source who didn't want to be identified told me.

So UV detectors are helpful and are now widely

[Continued on page 176]



Sketch of $20 bill indicates elaborate coding of currency when printed at the Bureau of Engraving and Printing. Secret Service urges "know your money."

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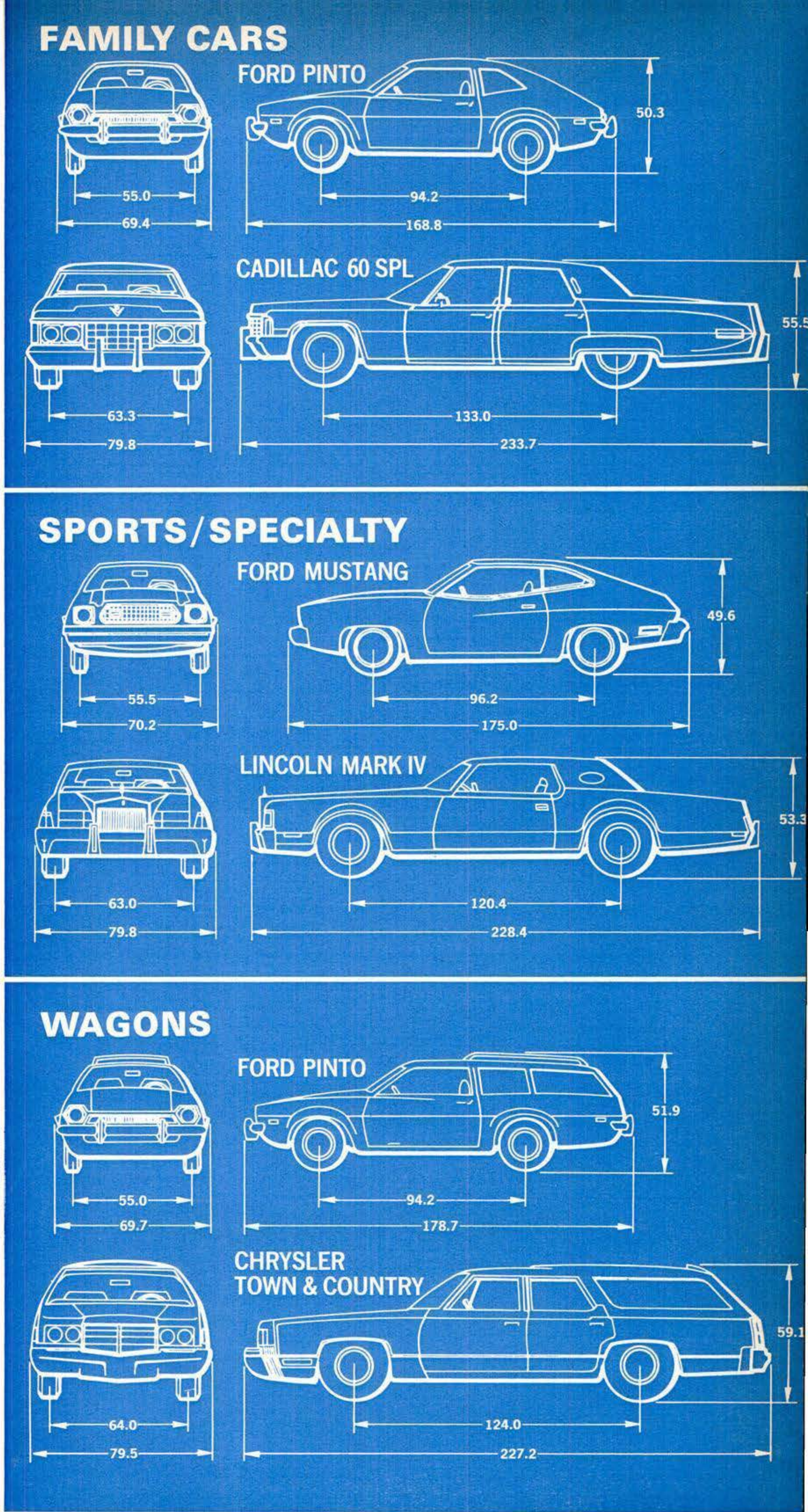
Picking Your '74 Car for More Miles per Gallon

Small cars burn less gas, but perhaps you need a big car and still want the best possible fuel economy. We'll tell you how to order the right power-train combination

By JAN P. NORBYE
PS Automotive Editor
and JIM DUNNE
PS Detroit Editor

If you're planning to buy a '74 car, you're sure to be interested in how many miles per gallon of gas it will give you. Although purchase price may be the most important factor to you—which is why we're giving you a table of the '74 models arranged according to base price (not including transportation charges, state and local taxes)—your second consideration may well be gas mileage.

The fuel shortage is a fact of life. Gasoline-refinery capacity is short, and will probably continue to be for at least three years. (It will take that long to build new refineries, and before oil can start flowing from Alaska.) Shale oil is too costly. Fuel from coal is many years away from your



DRAWINGS BY HANK TOMKALSKI

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FAMILY CARS

Price	Chrysler	Ford Motor	General Motors	American Motors
$2100		Pinto		
$2200				Gremlin
$2300			Vega	
$2400		Maverick		Hornet
$2500	Valiant	Comet		
$2600	Dart		Nova	
$2700			Ventura	
$2750			Apollo	
$2800			Omega	
$2900		Torino	Chevelle	
$3000	Satellite		Malibu	
$3100	Coronet	Montego	Le Mans	Matador
$3200		Gran Torino	Century	
$3300		Montego MX	Cutlass	
$3500	Fury I		Century Luxus	
$3600	Fury II	Custom 500	Cutlass Supreme	
$3700	Fury III		Bel Air	
$3800	Monaco	Galaxie 500	Century Regal	
$3900	Gran Sedan		Impala	
$4000		Monterey	Catalina	
$4100		Ford LTD	Caprice Classic	
$4200		Monterey Custom	Le Sabre	Ambassador
$4300	Monaco Custom		Olds Delta 88	
$4400	Chrysler Newport		Grand AM	
$4500			Delta 88 Royale	
$4600			Bonneville	
$4700	Newport Custom	Marquis	Grand Ville	
$4800			Le Sabre Luxus	
$5100	New Yorker		Olds 98	
$5200	NY Brougham	Marquis Broug.	Electra 225	
$6300			Cadillac Calais	
$6800			Sedan de Ville	
$7000	Imperial			
$7500		Lincoln Cont.	60 Special	

SPORTS/SPECIALTY

Price	Chrysler	Ford Motor	General Motors	American Motors
$2750		Mustang		Hornet X
$3000	Barracuda		Camaro	
$3100	Challenger		Firebird	Javelin
$3300	Road Runner		Cosworth Vega	
$3500	Charger	Cougar	Firebird Esprit	Javelin AMX
$3650	Sebring Plus			
$3800	Challenger Rallye	Cougar XR7	Firebird F400	
$4000	Charger SE		Monte Carlo	Matador X
$4800			Grand Prix	
$5500			Riviera	
$5700		Thunderbird	Toronado	
$8000			Eldorado	
$9000		Mark IV		

STATION WAGONS

Price	Chrysler	Ford Motor	General Motors	American Motors
$2400		Pinto		
$2500			Vega	
$2900				Sportabout
$3200		Torino		
$3300	Satellite		Chevelle	
$3400	Coronet	Gran Torino		Matador
$3500			Le Mans Safari	
$3600		Montego	Buick Century	
$3700	Satellite Regent			
$3800	Dodge Crestwood	G. Torino Squire		
$3900	Fury Suburban			
$4000	Monaco		Vista Cruiser	
$4150	Custom Suburban	Country Sedan	Bel Air	
$4300	Sport Suburban		Impala	
$4400		Monterey	Pontiac Safari	Ambassador
$4500		Country Squire	Caprice	
$4700	Monaco Custom	Marquis	Grand Safari	
$4850		Colony Park	Buick Estate	
$5000			Olds Cust. Cruiser	
$5250	Town & Country			

gas station. And our increasing dependence on overseas sources for crude oil makes the supply situation uncertain. The only thing you can be sure of is that prices will go up. Dollar-a-gallon gas may be tomorrow's reality.

All of that means that if you're planning to buy a '74 car, you'll want to pay close attention to the number of miles per gallon the car you choose will deliver. If it's too low, look for another car. Most Americans are doing that already. That's why you see small-car sales rising fast, and big-car sales dropping. Prices for small used cars have gone way up, while big used cars are harder to sell.

Reading the tables

We have listed a miles-per-gallon figure for each make and model, and all power-train combinations (except those sold in California only, where a lower NO_x emission standard will be in force in 1974). The mpg figures are based on results obtained in our own tests, and on test results published by the U.S. Environmental Protection Agency. The EPA has three test cycles (urban, highway, and country road), while we test at a constant speed (45 mph) but with variable throttle opening (due to gradients and curves).

Figures have been extrapolated from available test data for models and power trains not tested by EPA or PS. The figures in our table represent the gasoline mileage the average user is most likely to get in all-around driving. A particularly careful driver can probably do a little better, and you can certainly do much worse by lead-footed driving.

Many oil companies have issued pious appeals to motorists to slow down to save gas, and several state legislatures are debating a lowering of the speed limits. It's true that you can add four mpg by maintaining a steady 60 mph rather than 70 mph with a V8-powered intermediate--a jump from 16 to 20 mpg. But it's the car that really makes the difference. With a four-cylinder subcompact you can cruise at 70 mph and still get 26 mpg!

As our tables show, mileage

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Which car? Which engine? What miles-per-gallon?

	CYL.	CU. IN.	HP	MPG
CHEVROLET				
Vega	4	140	75	20
Vega	4	140	85	18.5
Cosworth Vega	4	122	110	17
Nova	6	250	100	16
Nova	V8	350	145	14.5
Nova	V8	350	185	12.8
Camaro	6	250	100	16.5
Camaro	V8	350	145	15.5
Camaro	V8	350	185	13.0
Camaro	V8	350	245	10
Chevelle	6	250	100	14.8
Chevelle	V8	350	145	12.6
Chevelle	V8	400	150	10.2
Chevelle	V8	454	235	8.5
Monte Carlo	V8	350	145	12.4
Monte Carlo	V8	400	150	10.0
Chevrolet	V8	350	145	10.8
Chevrolet	V8	400	150	8.7
Chevrolet	V8	454	235	8.0
PONTIAC				
Ventura	6	250	100	16
Ventura	V8	350	155	14.0
Ventura	V8*	350	170	14.2
Ventura	V8**	350	170	12.1
Ventura	V8	350	200	11.9
Firebird	6	250	100	16.5
Firebird	V8	350	155	15.0
Firebird	V8*	350	170	15.2
Firebird	V8	400	175	11.0
Firebird	V8	400	190	11.0
Firebird	V8	455	215	9.4
Firebird	V8	455	250	9.0
Firebird	V8	455	290	8.7
Le Mans	6	250	100	14.6
Le Mans	V8	350	155	12.4
Le Mans	V8*	350	170	12.5
Le Mans	V8**	350	170	11.3
Le Mans	V8	350	200	11.3
Le Mans	V8	400	175	10.0
Le Mans	V8	400	190	10.0
Le Mans	V8	400	200	9.4
Le Mans	V8	400	225	9.4
Le Mans	V8	455	215	8.3
Le Mans	V8	455	250	8.2
Grand Prix	V8	400	200	9.1
Grand Prix	V8	400	225	9.1
Grand Prix	V8	455	215	8.0
Grand Prix	V8	455	250	7.9
Grand Prix	V8	455	290	7.0
Pontiac	V8	350	155	10.2
Pontiac	V8*	350	170	10.2
Pontiac	V8	400	200	8.5
Pontiac	V8	450	225	8.5
Pontiac	V8	455	215	8.0
Pontiac	V8	455	250	8.0
OLDSMOBILE				
Omega	6	250	100	16
Omega	V8	350	180	13.3
Cutlass	V8	350	180	11.0
Cutlass	V8	455	250	10.6
Cutlass	V8	455	270	10.2
Delta 88	V8	350	160	10.4
Delta 88	V8	455	225	9.4
Delta 88	V8	455	250	9.2
98	V8	455	250	8.6
Toronado	V8	455	250	8.6

	CYL.	CU. IN.	HP	MPG
BUICK				
Apollo	6	250	100	16
Apollo	V8	350	150	14.0
Apollo	V8	350	175	12.7
Century	V8	350	150	12.5
Century	V8	350	175	11.2
Century	V8	455	180	9.6
Century	V8	455	225	9.0
Century	V8*	455	250	9.0
Le Sabre	V8	350	150	10.2
Le Sabre	V8	350	175	9.8
Le Sabre	V8	455	180	9.2
Le Sabre	V8	455	225	8.2
Le Sabre	V8*	455	250	8.0
Electra 225	V8	455	225	8.5
Electra 225	V8	455	250	8.5
Electra 225	V8*	455	250	8.5
Riviera	V8	455	250	8.8
Riviera	V8†	455	250	8.8
CADILLAC				
Calais	V8	472	220	8.4
Sedan de Ville	V8	472	220	8.4
60 Special	V8	472	220	8.2
Fleetwood	V8	472	220	8.0
Fleetwood 75	V8	472	220	7.0
Eldorado	V8	500	235	8.0
FORD				
Pinto	4	122	75	20.4
Pinto	4	140	85	19.6
Mustang	4	140	85	18.5
Mustang	V6	172	115	17
Maverick	6	200	84	15.5
Maverick	6	250	95	14.7
Maverick	V8	302	136	12.7
Torino	V8	302	136	13.2
Torino	V8	351	155	11.6
Torino	V8	351	244	9.8
Torino	V8	400	168	9.6
Torino	V8	460	202	9.2
Ford	V8	351	155	9.2
Ford	V8	400	168	8.8
Ford	V8	460	202	8.4
Thunderbird	V8	460	202	9.0
MERCURY				
Comet	6	200	84	15.5
Comet	6	250	95	14.7
Comet	V8	302	136	12.7
Cougar	V8	371	155	11.5
Cougar	V8	400	168	9.5
Cougar	V8	460	202	9.1
Montego	V8	302	136	13.2
Montego	V8	351	155	11.6
Montego	V8	351	244	9.8
Montego	V8	400	168	9.6
Montego	V8	460	202	9.2
Mercury	V8	400	168	8.6
Mercury	V8	460	202	8.4
LINCOLN				
Continental	V8	460	202	8.0
Mark IV	V8	460	202	8.6
PLYMOUTH				
Valiant	6	198	95	18.5
Valiant	6	225	105	17.5
Valiant	6	318	150	14.4
Valiant	6	360	170	11.6
Barracuda	V8	318	150	13.2
Barracuda	V8	360	170	10.8

	CYL.	CU. IN.	HP	MPG
Satellite	6	225	105	14.5
Satellite	V8	318	150	12.9
Satellite	V8	360	170	10.8
Satellite	V8	400	185	9.7
Satellite	V8	440	280	7.6
Fury	V8	360	145	10.6
Fury	V8	360	170	10.0
Fury	V8	400	185	9.4
Fury	V8	440	220	9.0
DODGE				
Dart	6	198	95	18.5
Dart	6	225	105	17.5
Dart	V8	318	150	14.4
Dart	V8	360	170	11.6
Challenger	V8	318	150	13.2
Challenger	V8	360	170	10.8
Charger	6	225	105	14.5
Charger	V8	318	150	12.9
Charger	V8	360	170	10.8
Charger	V8	400	185	9.7
Charger	V8	440	280	7.6
Coronet	6	225	105	14.3
Coronet	V8	318	150	12.7
Coronet	V8	360	170	10.6
Coronet	V8	400	185	9.6
Coronet	V8	440	280	7.6
Monaco	V8	360	145	10.6
Monaco	V8	360	170	10.0
Monaco	V8	400	185	9.4
Monaco	V8	440	220	9.0
CHRYSLER				
Newport	V8	400	165	9.6
Newport	V8	400	185	9.4
Newport	V8	440	220	9.0
New Yorker	V8	400	165	9.4
New Yorker	V8	400	185	9.2
New Yorker	V8	440	220	8.8
Imperial	V8	440	220	8.8
AMC				
Gremlin	6	232	100	20.0
Gremlin	6	258	110	19.0
Gremlin	V8	304	150	16.0
Hornet	6	232	100	19
Hornet	6	258	110	18
Hornet	V8	304	150	16
Hornet	V8	360	175	14
Javelin	6	232	100	15.5
Javelin	6	258	110	15.1
Javelin	V8	304	150	14.2
Javelin	V8	360	175	12.8
Javelin	V8	360	220	12.4
Javelin	V8	401	255	11.2
Matador	6	232	100	14.4
Matador	6	258	110	13.8
Matador	V8	304	150	13.2
Matador	V8	360	175	12.4
Matador	V8	360	220	12.0
Matador	V8	401	255	11.0
Ambassador	V8	304	150	12.8
Ambassador	V8	360	175	12.0
Ambassador	V8	360	195	11.6
Ambassador	V8	360	220	11.6
Ambassador	V8	401	255	10.6

* 2-bbl. dual exhaust
** 4-bbl. single exhaust
† = stage I

gains for light cars with small engines are even greater in the EPA and PS test-driving cycles than at steady speeds. Our advice is to look first for the car that has proved its fuel efficiency, and then develop driving methods that improve mileage further.

Manual vs. automatic

The tables assume that all cars have automatic transmissions (about 90 percent of all cars on U.S. roads are so equipped). Automatics are now standard on all full-size cars, and there's no manual-shift option.

On smaller cars, you can save 5-10 percent fuel by ordering manual transmission. Many people do. Vega buyers, for instance, surprised Chevrolet by ordering more manual than automatic transmissions (about 60 percent took standard three-speed or optional four-speed floorshifts).

The mpg ratings in our tables are based on cars equipped with the standard axle ratio for each powertrain combination. Note that economy axle options are available for most cars—and they will stretch your mpg.

Economy axles have *lower* numerical ratios: For instance, a car with a 2.93:1 standard axle ratio may be available with a 2.76:1 economy axle (against a 3.36:1 "performance" axle). Shun equipment with the term "performance." That means the car is geared for acceleration, not for steady highway speeds. Tests have proved that a 10-percent change in axle ratio—up or down—will result

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in a loss or gain of 0.6 mpg at a steady 70 mph in an intermediate with automatic transmission.

Your tires have a great effect on fuel mileage. We recommend radials. They run with lower friction losses, and give five to 10 percent better fuel economy, depending on conditions. That can mean a gain of 0.4 mpg at a steady 70 mph—more in urban and country-road test cycles.

Pounds and horsepower

Tests have proved that fuel consumption depends mainly on vehicle weight and frontal area rather than on engine size. Since all U.S. cars have almost the same aerodynamic drag coefficient (about 0.45), total air drag depends mainly on car size. Ten-percent increase in frontal area corresponds roughly to a 10-percent increase in drag.

That's enough to lower your gas mileage by 0.7 mpg at 70 mph (intermediate car with automatic transmission). And a 10-percent increase in weight will cause a drop of 0.4 mpg at 70 mph in an intermediate car with automatic transmission. In comparison, a 10-percent increase in engine displacement will lead only to a 0.2-mpg loss in fuel mileage.

These examples make it clear that you can't expect to improve your gas mileage much by ordering a smaller engine in a big car, but you can come out even by ordering a larger engine in a smaller car.

You need the room?

We realize that small cars aren't for everybody. If you need a car with a lot of interior room for passengers and/or luggage, pick a model that wastes no space on styling. Wagons and four-door sedans usually have good space utilization. Two-door sedans and coupes are less practical, and the sports/specialty cars sacrifice a lot of room to style.

If your job keeps you on the road, alone, with a couple of suitcases and sample bags, you can find space for your needs in a subcompact. If you frequently use the same car for trips with the family, you may have to go up to a compact. But if you take only one trip a year with the whole family, you might consider owning a subcompact and renting a big car for the vacation. Chances are you'll save money that way, as well as using less gas the other 48 or 49 weeks of the year.

If you habitually carry several passengers but little or no luggage, consider a compact over an intermediate. If your car is used mainly for carrying goods rather than people, but doubles as the family car, then you should look at station wagons. Unfortunately, the Big Three offer nothing in wagons between the very large intermediates and the very small subcompacts.

The only compact station wagon built in this country is the AMC Hornet Sportabout. We give it our highest recommendation, and look for Ford to offer Maverick/Comet wagons soon, just as we would like to see a Nova/Ventura wagon from GM and Valiant/Dart wagons from Chrysler. The need for small wagons is overwhelming (and the imports are filling it).

Wagons are taking a larger share of the whole market, and it's no fluke that the Pinto wagon is on its way to becoming the nation's best-selling station wagon—the place held by the big Ford wagons (Ranch wagon, Country Sedan, and Country Squire) for a good many years. But demand for the big wagons is on the wane, and the intermediate wagon, which is very close to full size in overall and interior dimensions, is not a satisfactory alternative.

Small sports cars

Personal taste and driving enjoyment have a lot to do with your choice of car. That's why we believe there will be a future for the sports/specialty cars—but perhaps only at the low end of the price scale. The Mustang II is the very epitome of today's trend. It's light and compact, and has no engine option with more than six cylinders. It's 400 pounds lighter than the '73 model and gives 20 percent more miles per gallon.

Public interest in small cars started and set a trend long before the fuel shortage became a reality. Many buyers were attracted by lower prices. But small-car buyers soon found that their cars had a number of advantages, such as greater ease of parking, higher evasive ability in a traffic emergency, and easier repairability (due to greater simplicity of construction, absence of power-assist options, etc.). Small cars (including compacts, sporty compacts, subcompacts, and imports) now account for 39.6 percent of the total U.S. market. In 1965 it was only 14.5 percent.

What about options?

Remember that many of them consume power. A significant amount of fuel is used in operating an air-conditioning compressor. It can steal up to eight hp. And it adds 90 pounds to your car's weight. Every pound you add detracts fractionally from gasoline economy. Power windows add 20 pounds; six-way power seat, 24 pounds; electric sunroof, 26 pounds; tape stereo, 21 pounds. And so on.

If you want these items, it seems logical to go to a smaller car: for instance, from a base-weight 3791-pound Malibu four-door to a base-weight 3292-pound four-door Nova.

Cutting down vehicle size also saves weight to allow for installation of options we recommend regardless of their additional weight, since they are safety-related—power steering, for instance. Our tests have proved that power steering can play a significant part in improving a car's evasive ability. Nonassisted steering tends to be too hard—or too low-geared—for fast action.

For car owners who carry heavy loads or who tow trailers, we also recommend automatic level control. It gives a balanced ride and keeps the headlights aimed on the road—not at the stars.

Handling packages

Often called heavy-duty suspension, cross-country suspension, or special suspension, they don't add much weight. They usually consist of higher-rate springs, stronger stabilizer bars, and shock absorbers with higher damping capacity. The handling package speeds up steering response and improves handling precision.

Limited-slip differentials add little or no weight. They have trade names like Positraction, Traction-Lok, and Sure-Grip. On slippery roads, they can make all the difference between going and not going—and between staying on the road and skidding into the ditch.

Electric-wire defrosters for the rear window are an excellent safety option, available on a growing number of cars. When the wire-grid type is not available, you can get a blower-type rear defogger (less effective but better than nothing).

Last year we included coolant-recovery systems in our recommended options. We have now eliminated it, since both GM and Chrysler have made that feature standard on all models. Ford and AMC would do well to follow (Ford includes a coolant-recovery system in some trailer packages but does not offer it separately).

Electronic ignition systems are growing in use, and we have a story on that elsewhere in this issue. Bumpers are new again this year. But the new seat-belt-cum-ignition interlock will be the most controversial feature of the '74 cars. You'll find both dis-

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cussed as well in separate articles.

Here's another change that may influence your buying decision: Ford Motor Co. no longer makes a six available in the intermediates, while a six is standard in all others. For the Torino and Montego, your smallest engine is the 302-cubic-inch V8; for the Cougar, the 351.

Ford has also dropped the 429 V8 (replaced by the 460). And Chevrolet has dropped the 307 V8 (replaced by the 350).

Oldsmobile is the only maker that offers valve rotators (standard in all V8s). They assure longer engine life between overhauls.

Reclining seats are available on all American Motors cars, Ford Maverick, and Mercury Comet, and are standard on the Pontiac Grand Am. As a new aid to driver comfort and a weapon against driver fatigue, Pontiac is offering adjustable pedals on the Catalina, Bonneville, and Grand Ville. The pedals are hinged on a bracket that moves four inches back or forward on a rail.

The GM ball-joint wear indicator has been extended from the full-size cars to the intermediates. The same goes for the audible warning device for excessive disk-brake pad wear.

If resale value is a point in your car-buying plans, look for a car that retains or increases its popularity. That's a sign of owner satisfaction, and an indication of quality. Pinto and Vega are in the top 10. Cutlass has gone from ninth to third most-popular car in three years. Nova has climbed from eighth to sixth. Valiant holds in 12th place.

To recap our advice for picking your 1974-model car:

- Select the smallest and lightest car that meets your needs.
- Check power-train combinations for candidates on our mpg list, and go for the highest number consistent with your horsepower requirements.
- Consider manual transmission if available.
- Specify radial-ply tires. No matter what the extra cost, they'll run longer, so your cost per mile will be lower.
- Study the sales literature and order forms for optional "economy" axle ratios.
- Eschew needless power-assist options that add weight to the car.
- Consider the options on our recommended list for higher driving safety.

If you go by these rules, you're more likely to keep rolling through the fuel shortage without stoppages in the next few years. PS

RECOMMENDED OPTIONS AND PRICES

	MANUAL TRANSMISSION	POWER STEERING	FRONT DISK BRAKES	HANDLING PACKAGE	RADIAL TIRES	LIMITED-SLIP DIFFERENTIAL	DEFROSTER IN REAR GLASS	ANTILOCK REAR BRAKES	AUTOMATIC LEVEL CONTROL
SUBCOMPACTS									
Vega	Std	$92	Std	$129	$80	$40	NA	NA	NA
Pinto	Std	NA	Std	$12	$74	NA	$43	NA	NA
Gremlin	Std	$100	$48	$23	$108	$44	NA	NA	NA
COMPACTS									
Maverick	Std	$92	$49	$12	$160	$44	NA	NA	NA
Comet	Std	$93	$49	$12	$160	$44	NA	NA	NA
Valiant	Std	$93	$22	$14	$140	$41	$49	NA	NA
Dart	Std	$93	$22	$14	$140	$41	$49	NA	NA
Hornet	Std	$100	$48	$23	$125	$44	NA	NA	NA
Nova	Std	$100	$68	$30	$106	$45	NA	NA	NA
Omega	Std	$113	$68	$21	$106	$45	NA	NA	NA
Ventura	Std	$113	$68	$100	$106	$45	NA	NA	NA
Apollo	Std	$113	$68	$15	$106	$45	NA	NA	NA
INTERMEDIATES									
Chevelle	Std	$113	Std	$17	$126	$45	$62	NA	$77
Torino	Std	$112	Std	$31	$160	$47	$62	NA	NA
Satellite	Std	$114	Std	$5	$152	$48	$49	NA	NA
Le Mans	Std	$113	Std	$9	$136	$45	$62	NA	$77
Cutlass	Std	$113	Std	$21	$136	$45	$62	NA	$77
Montego	Std	$113	Std	$17	$160	$47	$62	NA	NA
Coronet	Std	$114	Std	$14	$152	$48	$49	NA	NA
Matador	Std	$112	Std	$10	$140	$46	NA	NA	NA
Century	Std	$113	Std	$15	$136	$45	$62	NA	$77
Grand Am	$82	$113	Std	Std	Std	$45	$62	NA	$77
STANDARDS									
Chevrolet	NA	Std	Std	$17	$160	$45	NA	NA	$82
Ford	NA	Std	Std	$23	$160	$47	$62	NA	$87
Plymouth	NA	Std	Std	$14	$160	$48	NA	NA	NA
Ambassador	NA	Std	Std	$10	$150	$46	NA	NA	NA
MEDIUM STANDARDS									
Pontiac	NA	Std	Std	$9	$160	$45	$62	NA	$82
Oldsmobile	NA	Std	Std	$21	$160	$45	$62	NA	$82
Buick	NA	Std	Std	$15	$160	$45	$62	NA	$82
Mercury	NA	Std	Std	$23	$160	$47	$62	$190	$87
Dodge	NA	Std	Std	$14	$160	$48	NA	NA	NA
Chrysler	NA	Std	Std	$18	$160	$50	NA	NA	NA
LUXURY									
Cadillac	NA	Std	Std	NA	$160	$56	$72	$205	$82
Imperial	NA	Std	Std	$21	$160	$57	NA	NA	NA
Lincoln	NA	Std	Std	NA	Std	$56	$85	$192	NA
SPORTS/SPECIALTY									
Mustang	Std	$99	Std	$30	$140	$45	$48	NA	NA
Camaro	Std	$113	Std	$30	$128	$45	NA	NA	NA
Firebird	Std	$113	Std	$98	$138	$45	NA	NA	NA
Hornet X	Std	$100	$48	$23	$125	$44	NA	NA	NA
Barracuda	Std	$104	Std	$14	$155	$41	NA	NA	NA
Challenger	Std	$104	Std	$14	$155	$41	NA	NA	NA
Javelin	Std	$112	$48	$29	$150	$44	NA	NA	NA
Road Runner	Std	$114	Std	$5	$152	$48	$49	NA	NA
Charger SE	Std	$114	Std	$14	$152	$48	$49	NA	NA
Cougar	Std	$113	Std	$17	$160	$47	$62	NA	NA
Matador X	Std	$112	Std	$10	$140	$46	NA	NA	NA
Monte Carlo	Std	Std	Std	$17	Std	$45	$62	NA	$87
Grand Prix	NA	Std	Std	$9	Std	$45	$62	NA	$87
Thunderbird	NA	Std	Std	$28	Std	$48	$82	$190	NA
Riviera	NA	Std	Std	$15	Std	$45	$62	NA	$87
Toronado	NA	Std	Std	$21	Std	NA	$62	$190	$87
Eldorado	NA	Std	Std	NA	Std	NA	$62	$205	Std
Mark IV	NA	Std	Std	NA	Std	$57	$90	$190	NA

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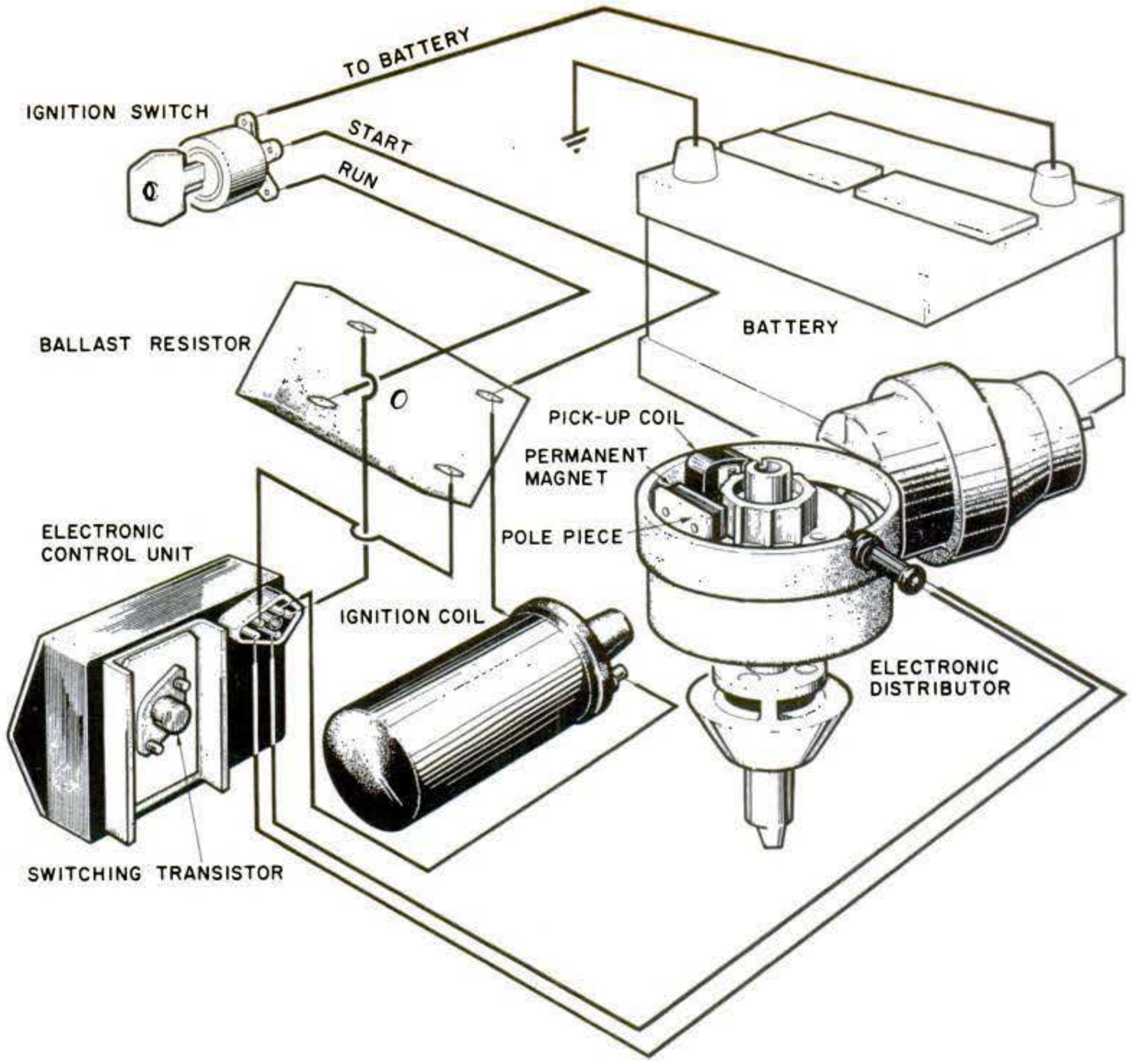
'74 CARS:

Electronic Ignition— Stronger Sparks, Surer Starts



With new systems coming at Ford and GM, it won't be long before electronic ignition is standard in all U.S. cars

By JAN P. NORBYE
PS Automotive Editor

Everybody agrees that the electronic ignition system is the coming thing. Here's how Detroit stands on it now:

Only Chrysler has standardized it across the board, for all domestic passenger cars and light-duty trucks. Ford and GM have been toying with different types of electronic ignition since 1965. Ford's latest system is now standard on the company's two biggest V8s, but GM has not yet gone beyond the optional equipment stage. American Motors has no activity on electronic ignition, and seems to be awaiting the availability of an advanced low-cost system from an independent supplier.

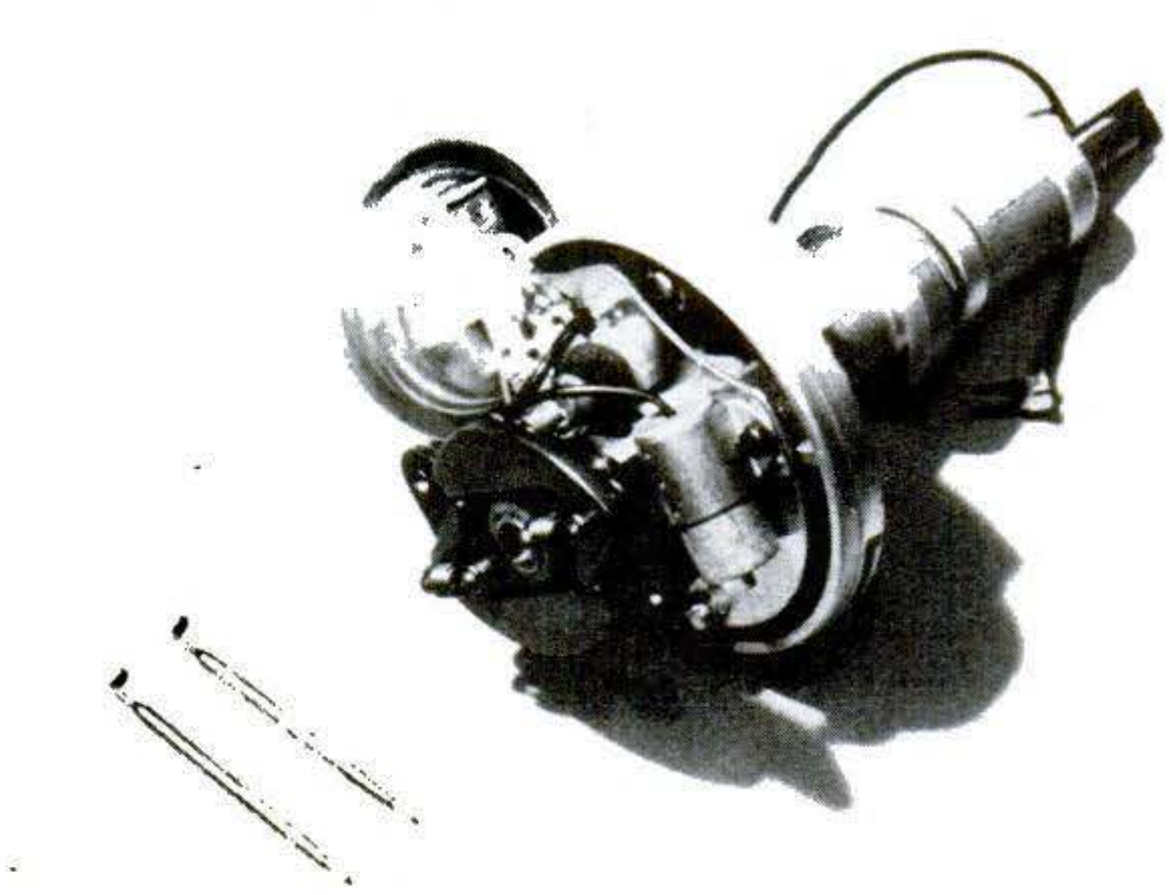
The Chrysler system. It may be considered typical of current practice; the drawing (above) shows the circuitry and individual components. The distributor is wired to an electronic control unit on the firewall. Inside it is an electronic circuit board that interconnects various resistors, capacitors, transistors and diodes.

The electronic control unit performs two key functions:

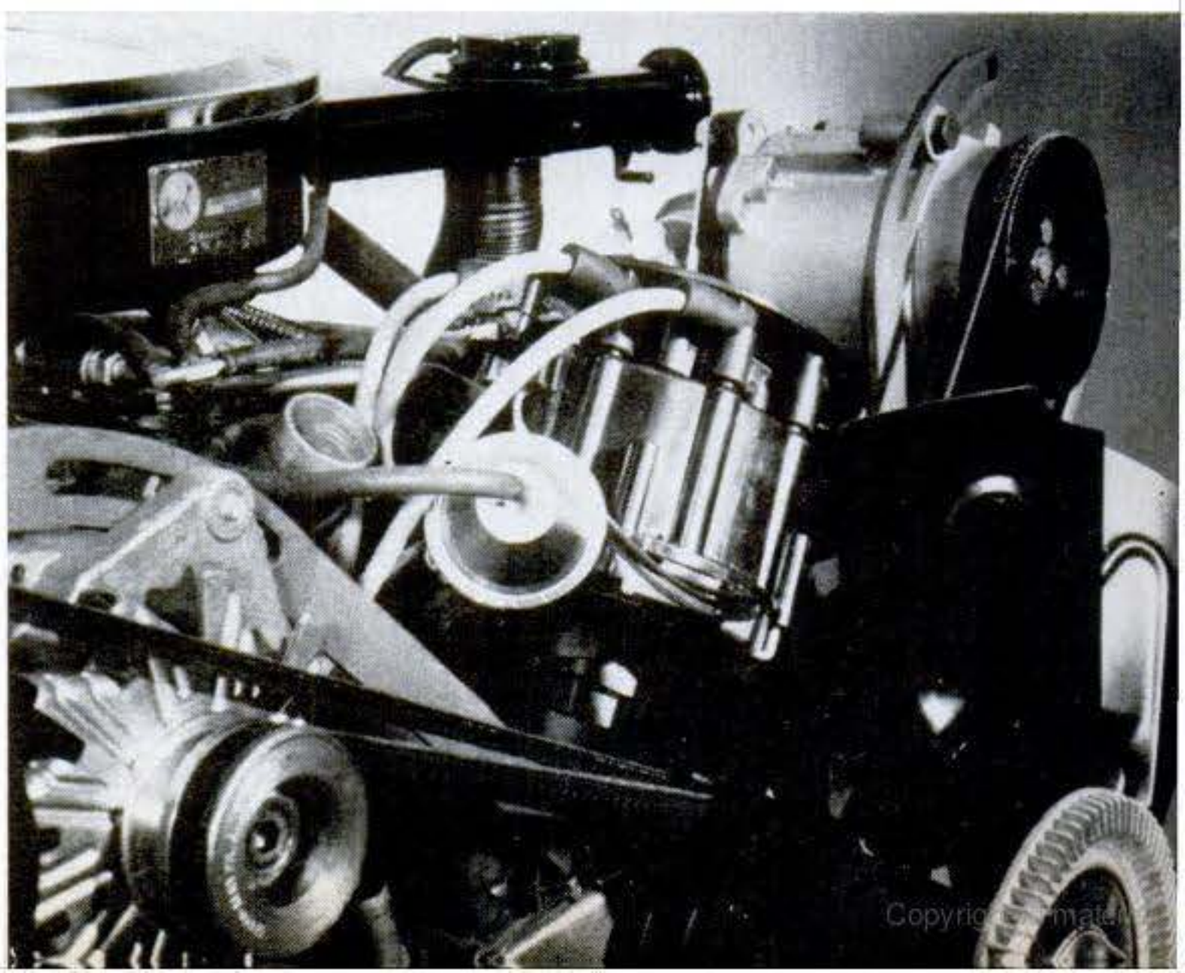
- It senses a signal from the magnetic generator in the distributor and uses it to control the switching on and off in the low-tension circuit to the coil, which generates the spark.
- It senses and controls the dwell angle (the number of degrees of rotation the breaker points are closed in a conventional system).

The distributor in the electronic system has no breaker points, contact-breaker mounting plate, or rubbing block or condenser. The distributor shaft has no cam lobes.

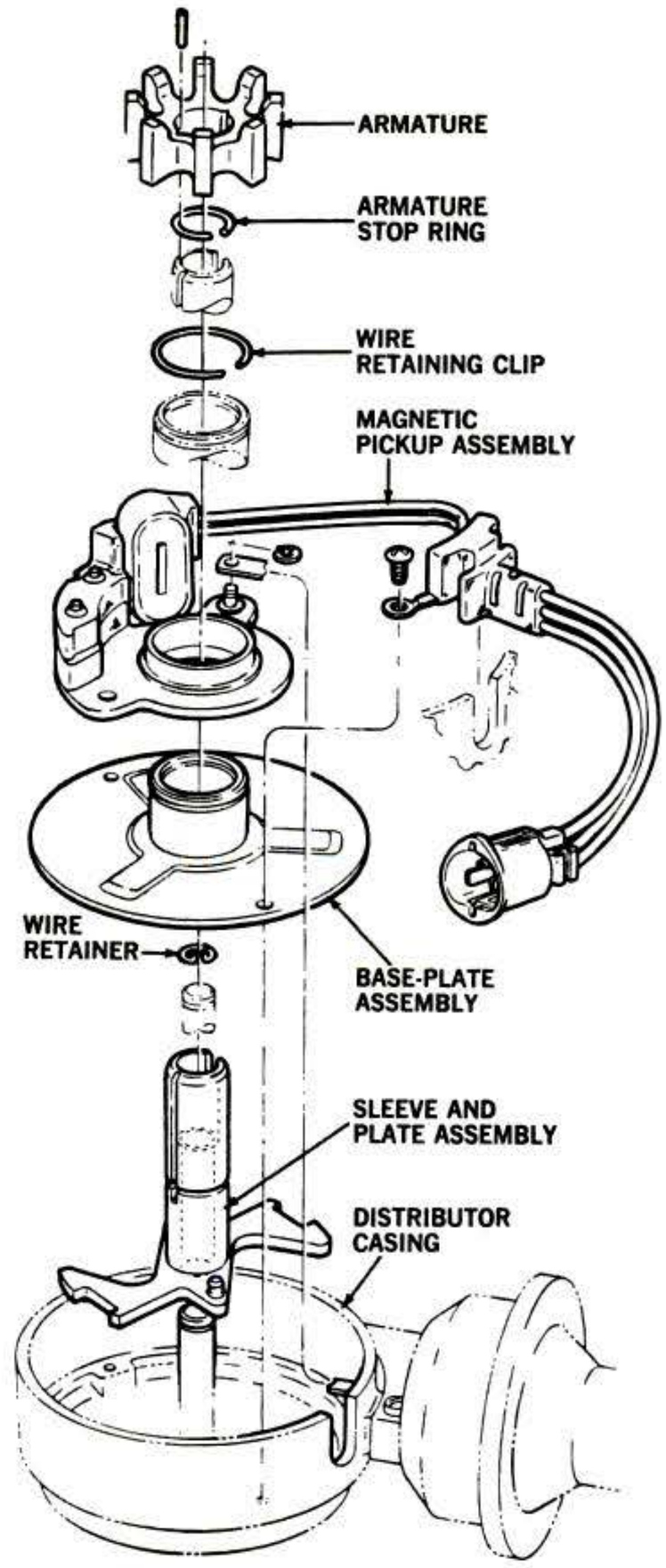
Oversize distributor for Delco high-energy ignition system makes it possible to generate and time extra-strong sparks without crossfire or terminal-to-terminal interference. Insulation in high-tension circuit got extra attention.



Fitted on Buick 455-cubic-inch V8, the Delco high-energy ignition distributor looms as large as the alternator. It's completely unitized, sealed, and pretested for maximum reliability. It will be available on all '74 Buick V8s.



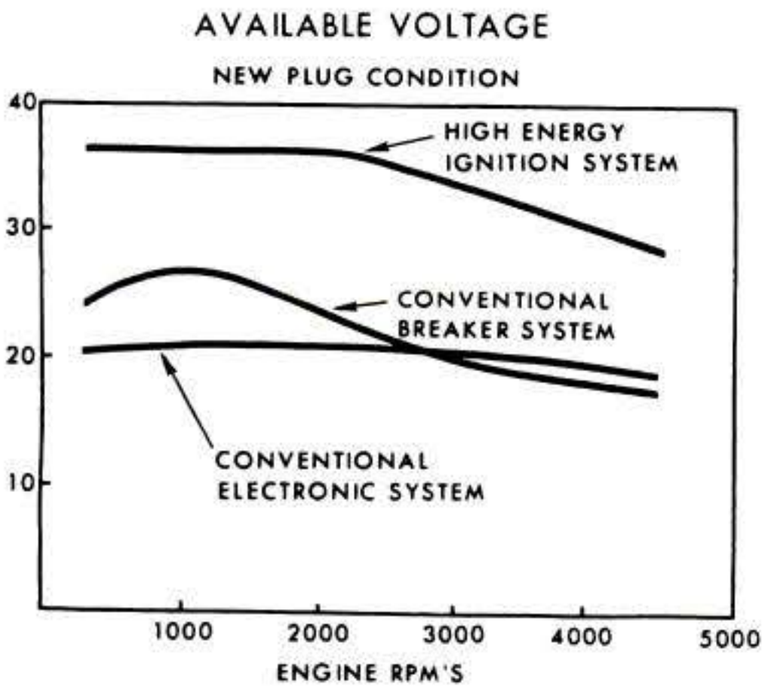
Motorcraft solid-state ignition is standard on Ford 400- and 460-cu.-in. V8s. Points and condenser are replaced by permanent-magnet low-voltage generator, and coil is oil-filled for higher dielectric efficiency, to lower risk of shorting. Starting voltage reaches 32,000 at 200 rpm, 26,000 in normal driving.



The components of Motorcraft solid-state distributor show its special construction. There are no wearing parts, such as contact points or rubbing blocks.

Instead you find a permanent-magnet low-voltage generator. For V8 engines, the generator consists of an armature with eight gear-like teeth revolving with the distributor shaft, and a permanent magnet with a pole piece that is riveted in place to provide a preset gap with the armature. The armature works as a rotating pole piece; the coil as a stationary pickup. When opposite poles pass, a small voltage induced in the magnetic generator sends a signal to the electronic control unit. The distributor base, cap, rotor, vacuum, and centrifugal spark-advance mechanisms are essentially the same as in conventional ignition systems.

The big advantages of electronic ignition are higher voltage throughout the speed range, which enables the ignition system to fire worn, fouled, and corroded plugs; faster voltage rise rate, which means it takes less time to manufacture the spark and assures reliable firing at high rpm. The system is almost maintenance-free and gives longer plug life, too. Chrysler specifies 18,000 miles between plug changes.



Delco high-energy ignition provides drastically higher voltage than conventional breaker-type or other GM electronic systems. Extra spark strength is maintained throughout engine's rpm range, but curve has linear drop after 2200 rpm.

GM's Delco system. This new high-energy ignition works on the same principles, but operates with considerably higher voltage. The new Delco-Remy coil delivers 50 to 75 percent more voltage than the coil in the former Delcotron system. In the critical starting zone, where the conventional breaker-point system delivers only about 15,000V, the high-energy ignition system will deliver about 37,500.

Unfortunately GM is a long way from standardizing it. The Delco high-energy ignition system is optional on the 455-cubic-inch Oldsmobile V8 (for full-size '74-models only) and on all 1974 Buick engines. The Delcotron ignition system that was optional on the Chevrolet Corvette and Pontiac Grand Prix has been discontinued. Chevrolet and Pontiac offer no electronic ignition at all, on any model, for '74.

Do not confuse Chevrolet's new Unipac distributor with electronic ignition. It's a conventional system, and the news in the Unipac is that the breaker-points assembly has been made integral with the capacitor (condenser). This eliminates the wire lead to the capacitor, and does away with the metal shield that used to cover the points. Radio reception is improved and service accessibility is made easier. But that's all.

Presumably the GM plan is to make the high-energy ignition system available on more engine types as Delco builds up its production capacity; but that won't happen overnight, and there's next to no chance that Chevrolet could standardize it for the '75 models.

Ford Motor's ignition. The Motorcraft system differs from Chrysler's in detail only.

Ford is in a better position with two standard applications (400- and 460-cubic-inch V8s) in 1974. You can expect Motorcraft solid-state ignition to become optional on Ford's smaller engines during the '74 model year, and be standardized on all Fords and Mercurys in 1975. PS

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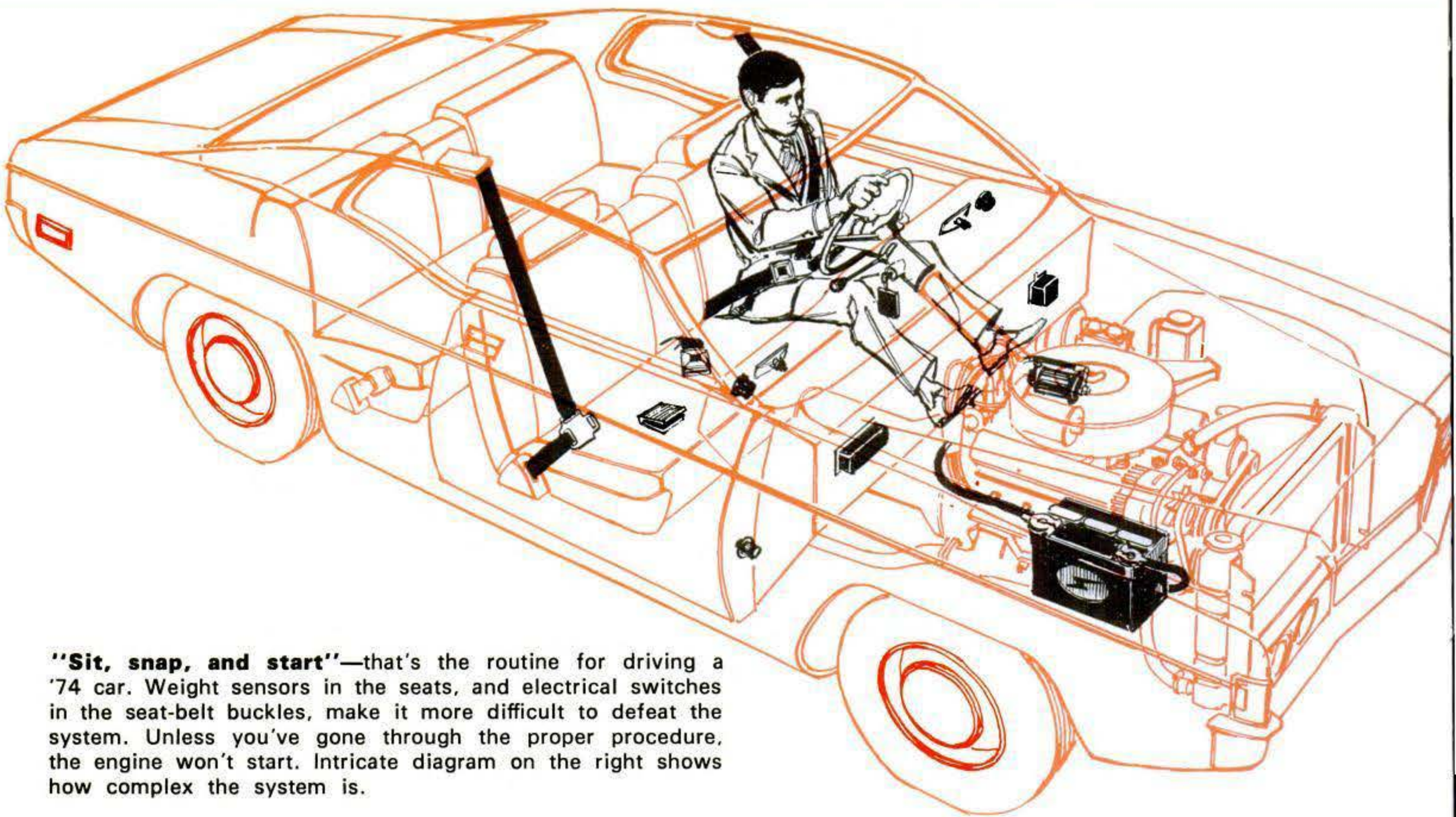


"Sit, snap, and start"—that's the routine for driving a '74 car. Weight sensors in the seats, and electrical switches in the seat-belt buckles, make it more difficult to defeat the system. Unless you've gone through the proper procedure, the engine won't start. Intricate diagram on the right shows how complex the system is.

For '74, It's Belt Up or Don't Go

Problems ahead with this complex system? Probably. But lives will be saved

By **JIM DUNNE** / *PS Detroit Editor*
DRAWINGS BY HANK TOMKALSKI

You won't drive anywhere in the '74 cars unless you're strapped in. Federal safety standards now specify three-point belts with ignition interlock. You can't start the engine unless you buckle up. The system is designed for your safety and should be very effective, in terms of increasing seat-belt use, as well as in giving better protection in an accident.

The interlock will be installed in 10 million vehicles in the next 12 months. There are 60 parts in the complete belt system, including a computer (logic module), sensors, override switch, inertia locks, and buckle switches.

But the interlock devices are new, and could be highly susceptible to failure. "We will be making an all-out effort for reliability, knowing how unhappy people will be if they turn the key and nothing happens," says Roy C. Haeusler, Chrysler's safety chief. "Nevertheless, there will be such cases . . ."

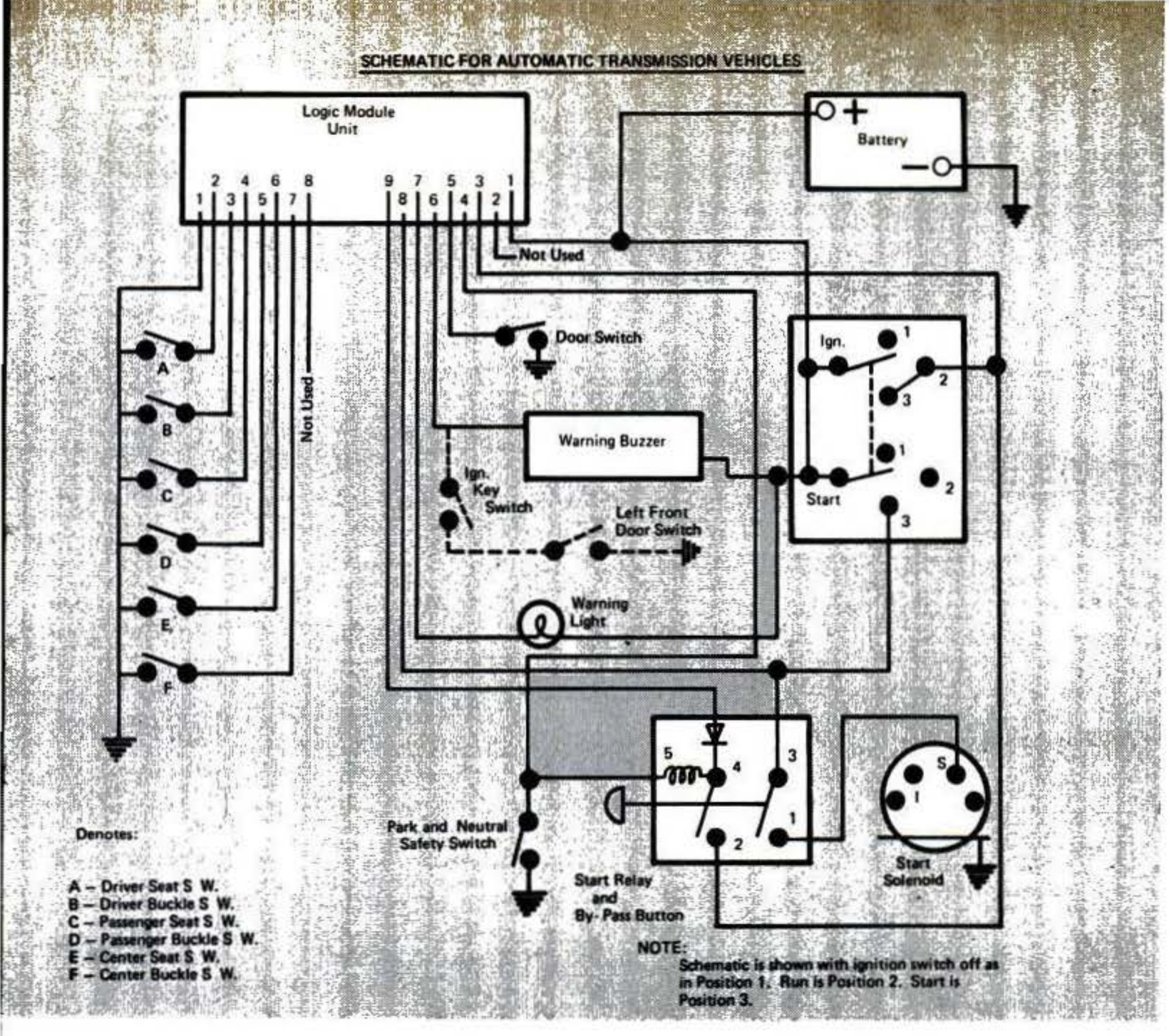
At Fisher Body, which has responsibility for the GM system, ficials say the same thing: "O testing has been extensive, but expect some failures and problems the field."

Detroit engineers expect th things will go wrong when buye take their cars to the ultimate te But GM engineers state that reli bility of the interlock system projected to be better than in t U.S. space program. For the mo part, the various auto-makers' sy tems are essentially identical.

W. C. McDonald, safety produ planning manager at Ford, says th if the car doesn't start the first tim you should get out of the car ar go through the "Sit, Snap, ar

Start the car from outside? You can, with door open or closed, transmission in Park. But the buzzer goes off when you sit down to drive, though the engine keeps running.

Lift your body off the seat cushion, and you can start t engine from inside car with the belts unbuckled. This m become S.O.P. for parking-lot attendants.



Back-seat rider in two-door GM car unlocks front-seat back, which swings forward (with belt) to allow exit.

Start" routine once more. If that doesn't work, there's an override button under the hood that allows the engine to be started, bypassing the interlock.

Can't fool the system. Not by buckling the belts before you get in, or leaving them buckled behind you when you get out. The computer must get its logic sequence right, or it will block the circuit to the starter.

But the engine won't stop once it's been started, even if you remove the belts. If the engine stalls and you want to restart, the interlock will not interfere.

Ford uses a special type of inertia reel to lock the shoulder belt. It's sensitive to car's speed, not to the pull on the belt. On GM, AMC, and Chrysler cars, it's speed of the belt at the reel that determines when to lock and hold.

Roy Haeusler cautions that drivers should not confuse the inconvenience or possible failure of the interlock with the government's safety program. The possibility of problems with the interlock doesn't mean that the safety aspect of the new belts should be criticized. Everybody agrees that the interlock system will save lives. One study indicates that half of all traffic fatalities could be prevented if all cars had the interlocks.

How effective is the lap-and-shoulder-belt combination compared with other restraint systems? "The best," says a GM safety engineer. According to a GM study, 31 percent of today's traffic deaths could be prevented if belts and shoulder harnesses were used. No other type of restraint system can approach that figure—not even the much-touted airbag system, used in combination with a lap belt. PS

Shoulder strap partially blocks exit but is easily stretched out of the way to allow back-seat passenger to exit.

Shoulder belt fits loosely when driving, giving driver full freedom to lean forward or across car. But inertia reel snaps tight if belt is pulled sharply, as in a crash.

Comfort clip on GM belts is designed to ease pressure or rubbing of belt against body on long trips, while keeping the belt firmly located for proper protection.

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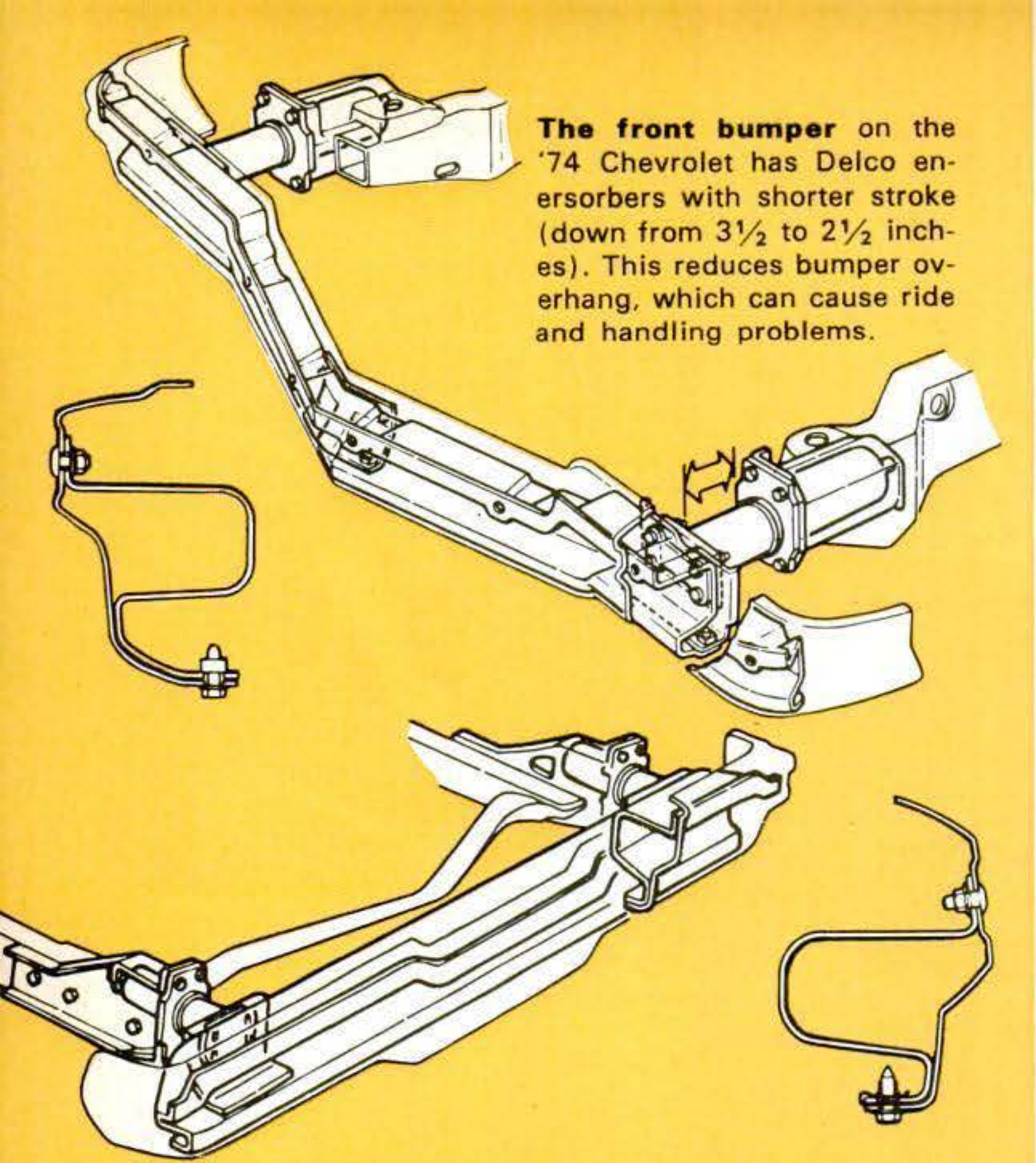
New Bumpers Have Uniform

Stricter standards produce more variety, and one auto maker changes his mind

By JAN P. NORBYE / *PS Automotive Editor*



The front bumper on the '74 Chevrolet has Delco enersorbers with shorter stroke (down from 3½ to 2½ inches). This reduces bumper overhang, which can cause ride and handling problems.

Rear bumper on '74 Chevrolet also gets the Delco enersorbers that absorb energy by passing hydraulic fluid under pressure from one chamber to another.

If you had visions of vintage train cowcatchers and tank-like armor when you first heard about the '74 bumper standards, you were not alone. There were hundreds of engineers in Detroit who had nightmares about such contraptions. Well, here are the '74 cars, and their bumpers look quite stylish as well as more effective.

Both the front and rear bumpers are capable of withstanding five-mph impacts without damage to safety-related items. That includes headlights and turn signals, hood latch, cooling system, exhaust system, and fuel system.

All the '74 cars have bumpers that present a rubber-and-steel face in the area 16 to 20 inches above ground level. That's because the pendulum used in the tests may hit anywhere between 16 and 29 inches. The pendulum is shaped like an enormous hammer. Weight is adjustable, so that pendulum weight matches the weight of the car that's on test.

Impact speed is five mph, and the pendulum hits six times in different places on the frontal area of the bumper. Then there's an additional three-mph hit with the pendulum at a 30-degree angle at either corner of both front and rear bumpers, at a height of 20 inches.

After completing the pendulum test, the car is driven at five mph into a flat, fixed, vertical barrier, forward and backward.

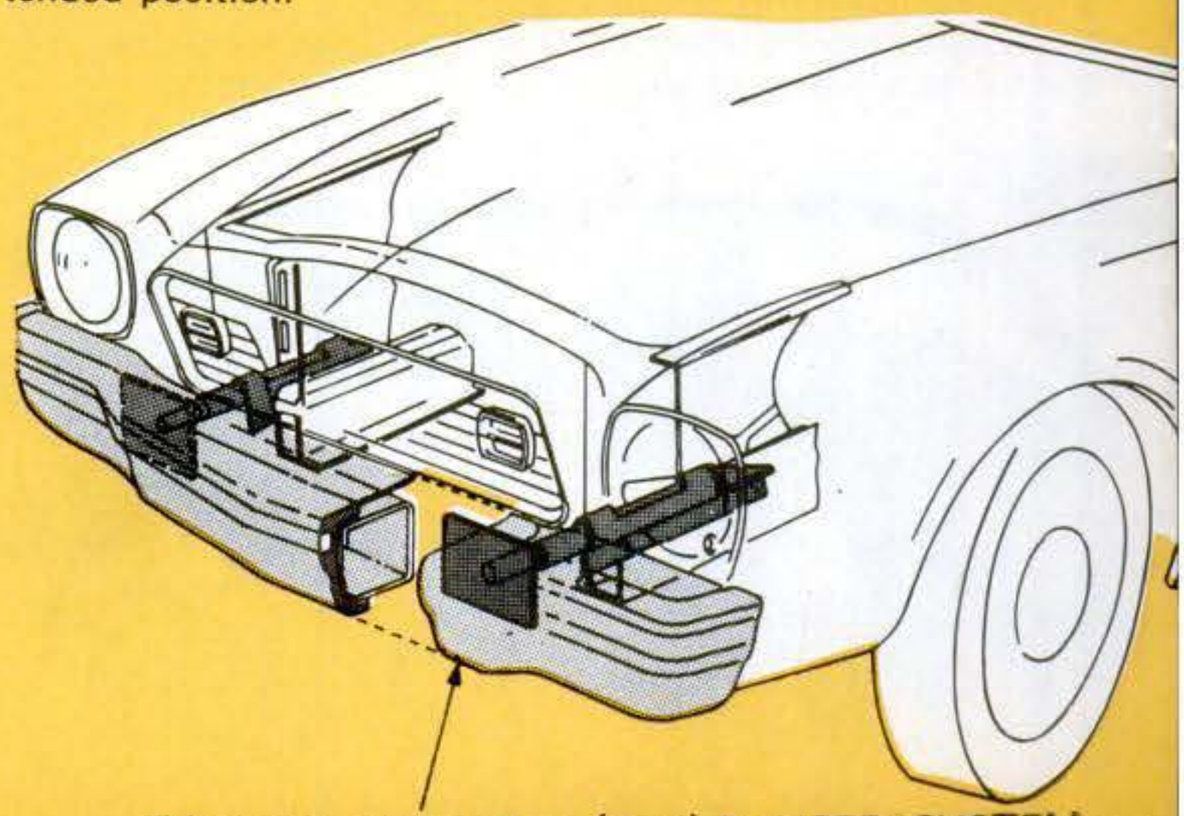
Some cars are exempted from this requirement. De-

Comet bumper is backed by system of rubber blocks in a channel, restoring the bumper to original position after impact. Supports are hidden below bumper panel.

AMC Ambassador bumper has improved bumper design with hydraulic backup system. Bumper face projects slightly in center section, curves around at sides.

Ford Mustang has its own system

Ford has developed a new preloaded hydraulic energy absorber to back up the front and rear bumpers on the Mustang. The cylinders are filled with a silicone-based fluid, baked into a gel-like consistency. The substance is called polygel, and was chosen because it is compressible and resists leaking. The polygel compound is compressed at 8500 psi during assembly to preload the bumper in its fully extended position.



POLY-GEL MITIGATOR (PGM) BUMPER SYSTEM

Height, Take Angle Impacts

troit said it could not possibly get new-type bumpers into production for all its car lines in time for the September 1, 1973 deadline. The Department of Transportation granted a one-year delay to a group of cars that is best described as the sporty compacts.

Which are exempt? The official government definition specifies a wheelbase of 115 inches or less, and two doors only, with hardtop roofs, to qualify for the exemption. GM's sporty compacts, Camaro and Firebird, meet the '74 standards. But the AMC Javelin, Dodge Challenger, and Plymouth Barracuda do not.

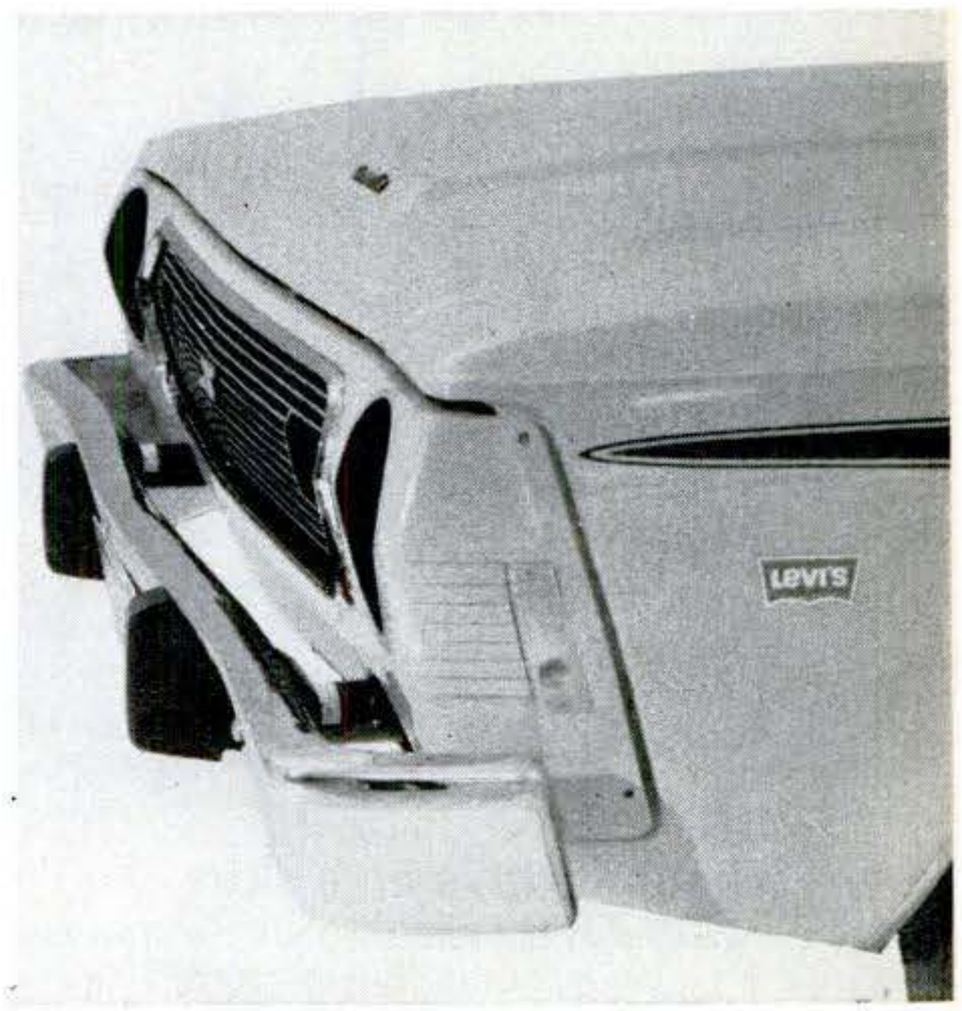
There are three different types of bumper systems on the '74 cars: 1) Urethane bumper structures. 2) Flexible rubber blocks. 3) Hydraulic energy absorbers. The third type is the most common. Chrysler just abandoned its rigid bumper mounts, intended to distribute the impact forces throughout the entire chassis and body, for its new Fury, Monaco, Chrysler, and Imperial in favor of hydraulic energy absorbers.

Who's using what? Ford sticks with the rubber blocks, interposed between two steel channel sections telescoping into each other. This system is used for all full-size Fords and Mercurys, Torino and Montego, Pinto, Maverick and Comet, Continental and Mark IV. But the rear bumpers on the Pinto, Maverick, and Comet use the new polygel mitigators developed for the new Mustang.

American Motors uses hydraulic energy absorbers on all cars except the Javelin. On the Hornet and Gremlin, the bumpers are freestanding (without a cover panel between the bumpers and the body sheet metal). It looks neat and clean, and saves weight and cost.

Meeting the new bumper standards has unfortunately added both weight and cost to the '74 cars. Depending on vehicle size, the new bumpers weigh 80 to 160 pounds per car more than pre-'73 bumpers. That corresponds to an extra cost of $100 to $200 per car. Remember, however, that a large portion of this cost increase was tacked on in '73.

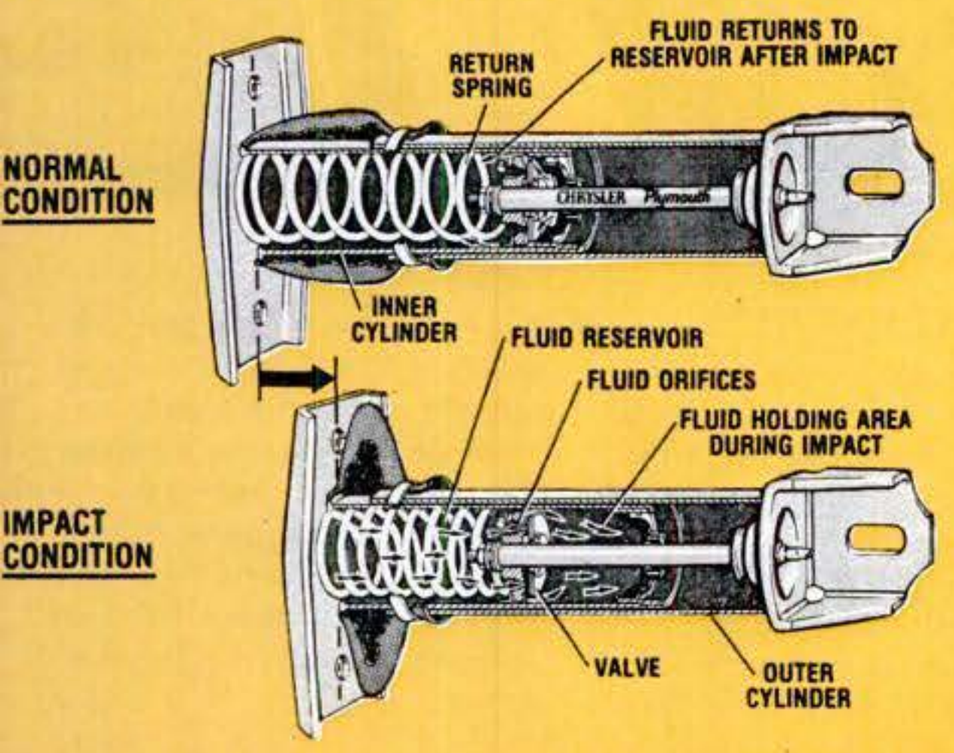
When the industry successfully meets the five-mph bumper standards, will the government set 10-mph requirements? Probably not. That would quadruple the impact forces, so that a 10-mph bumper on a 4000-pound car would be subject to a load of 140,000 pounds. That would bring a severe weight penalty, and make matters worse still. PS



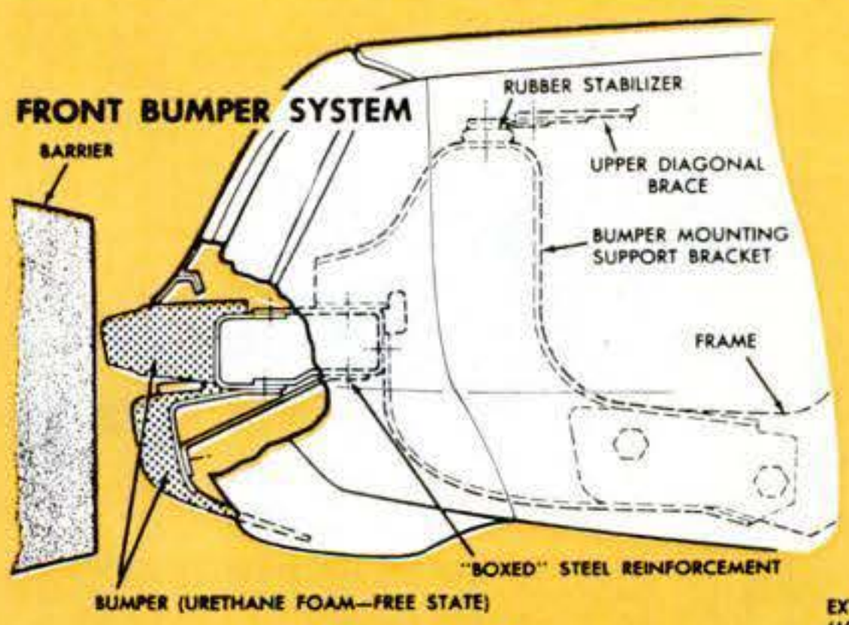
AMC Gremlin X bumper system uses telescopic gas-and-oil cylinders. Bumper is freestanding, without cover panels over the forward section of the self-restoring cylinders.

Firebird has new materials

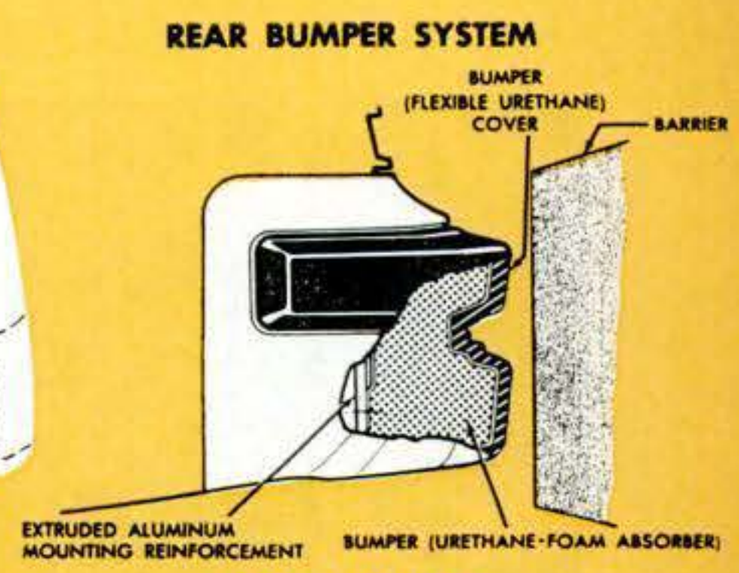
Firebird front and rear bumpers are made of cast urethane (right) that provides all the flexing needed. The solid bumper backup system is mounted on the ends of the frame. Chevrolet Laguna (not shown) also has a urethane bumper. Below, the new bumper system chosen by Chrysler Corp. for its new generation of full-size cars. It's a hydraulic energy absorber with a metallic return spring



BUMPER HYDRAULIC UNIT



BEFORE IMPACT



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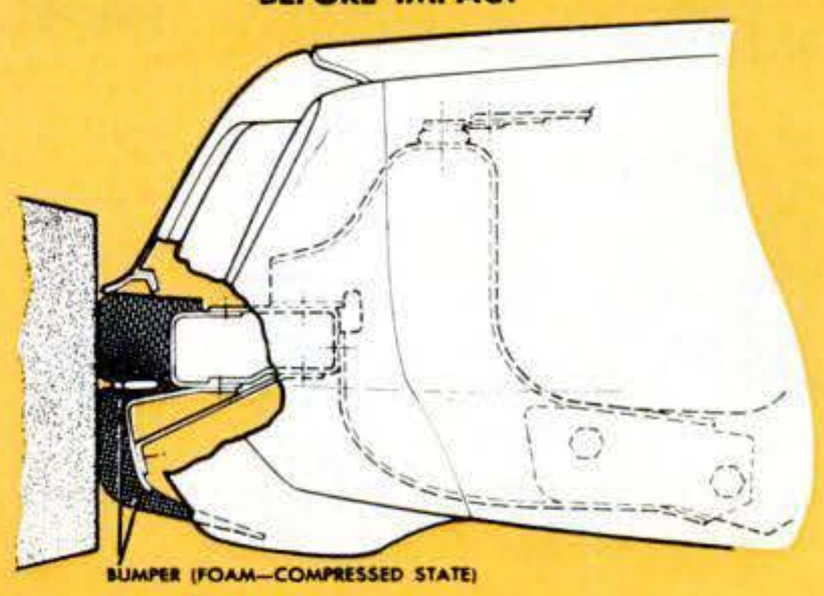
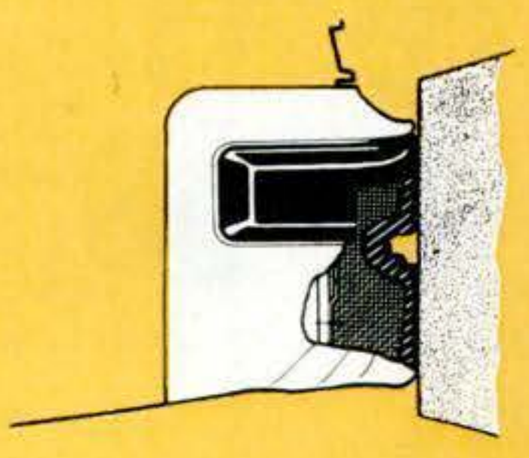


DURING IMPACT



DURING IMPACT

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What's New

A PICTURE ROUNDUP OF NEW PRODUCTS AND DEVELOPMENTS

Automatic scorer

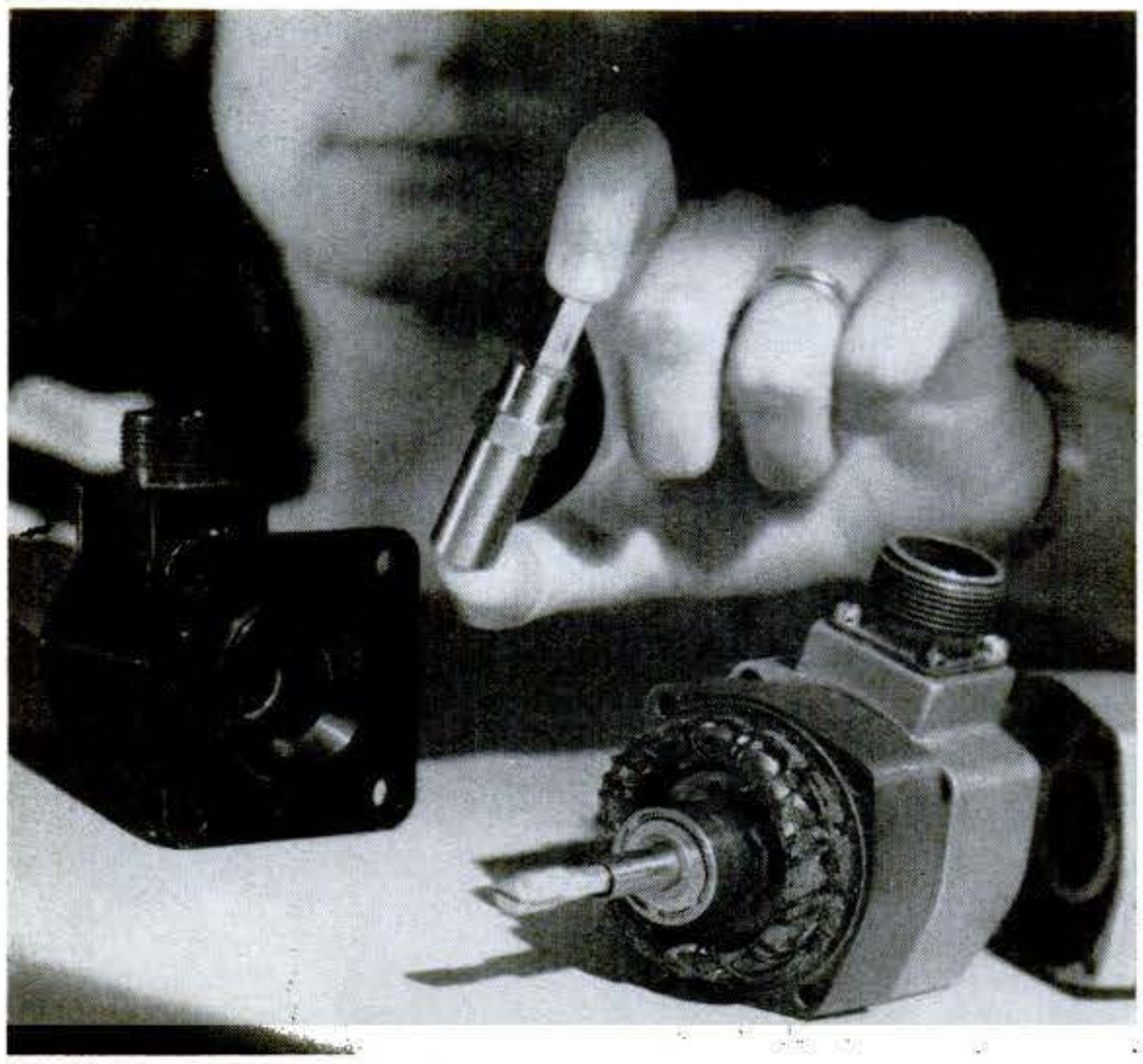
Even people who can't add can keep score with the RCA-built Rapid Score bowling system. An electronic camera detects felled pins, a minicomputer calculates the score, and a TV-like screen automatically posts the results.

A warship that rides on a skirt

Is this the warship of the future? Could be. The British, who make the BH-7 hovercraft for Royal Interservice use, have been demonstrating the craft on the Potomac for the U.S. Navy. The BH-7, 78 feet long and 48 wide over its inflated skirt, has a normal maximum speed of 65 knots. As a supply craft, it can carry 17 tons; and in a combat role can be fitted with a variety of weapons. Power for the air-cushion craft comes from a 4250-hp Rolls Royce gas-turbine engine. The 21-foot propeller is said to be the largest in use in the world today.

Check-out

An Army man who plugs in this Vehicle Test Meter can tell almost immediately the state of his vehicle's health. Sensors in test vehicles monitor various components, and the VHM tells whether they're okay, sick, or dead. RCA developed the system for the Army.



Strongest magnet

The world's strongest permanent magnet—in the rotor (center) of an airplane tachometer generator—may eliminate burned-out-bearing problems by eliminating the bearings. The GE cobalt/rare-earth magnets have shown a maximum energy of over 25-million gauss-oersteds.

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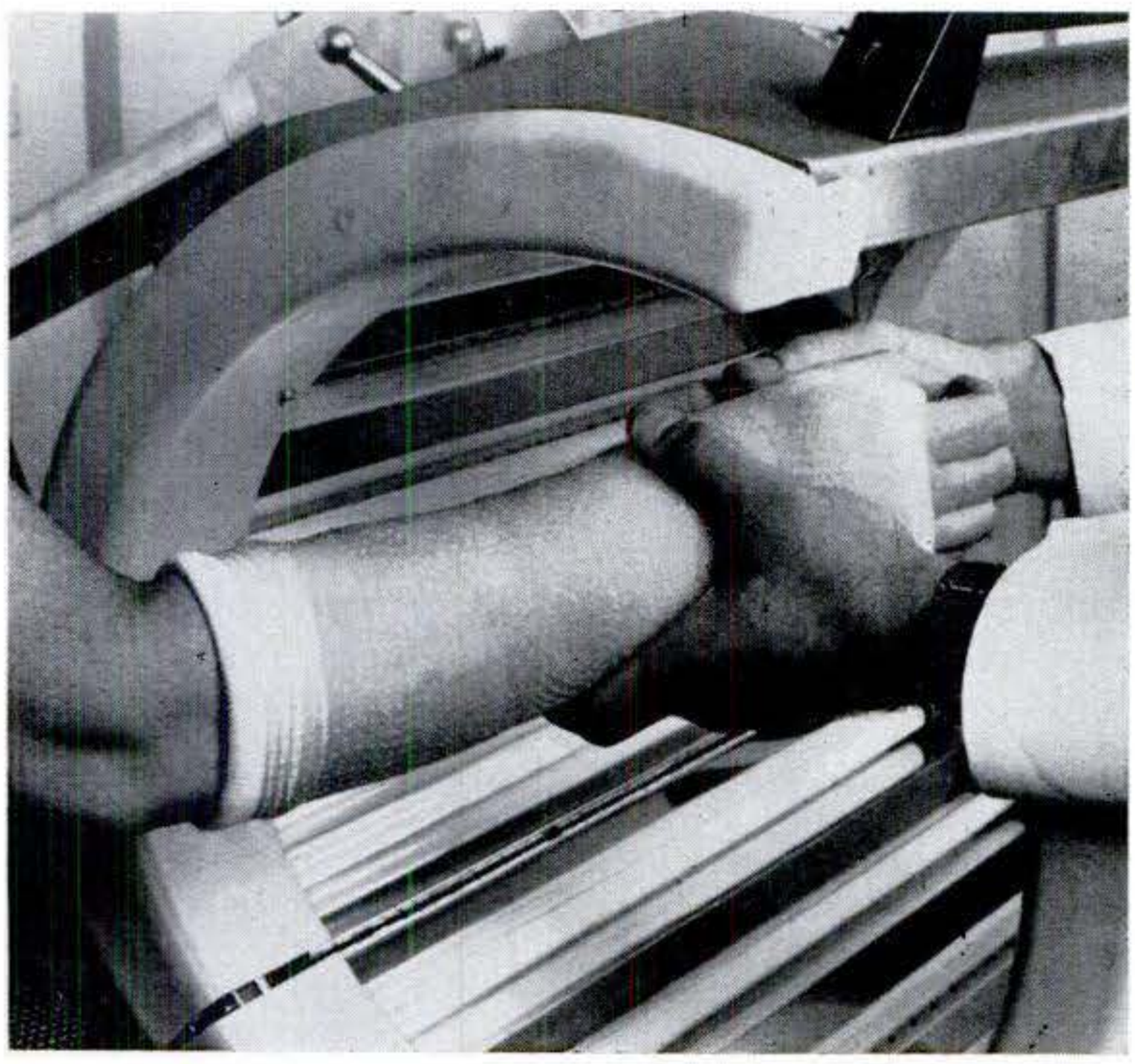
Cool head

Why is stock-car racer Richard Petty (above) smiling? Because his head is cool. Petty tested that NASA-developed helmet in a 120-degree chamber with no sweat. (Sweat is a problem in racing.) The helmet is lined with polyurethane patches that have tiny channels for cool-water circulation.

Dome home that goes up in a day

There's no structural support in the Casa Manana dome home other than its molded panels—made of a fiberglass sandwich with a urethane-foam core and prefinished interior and exterior surfaces. The dome encloses some 1100 square feet of floor space, with another 750 square feet available as a second floor. The maker (Western Hemisphere, Ltd., 8113 Rush St., Fort Worth, Tex. 76116) claims that the dome can be erected on a prepared slab foundation in one day by four men—and at a third the cost of conventional construction.



Glass cast

Good-bye to plaster casts, says Merck Sharp & Dohme, the company that developed this new system. The fiberglass tape, impregnated with a photosensitive resin, is shaped to the limb, then cured (in 3-5 minutes) under a special near-UV lamp. The cast, a third to half the weight of plaster, can be immersed in water.

Emergency caller

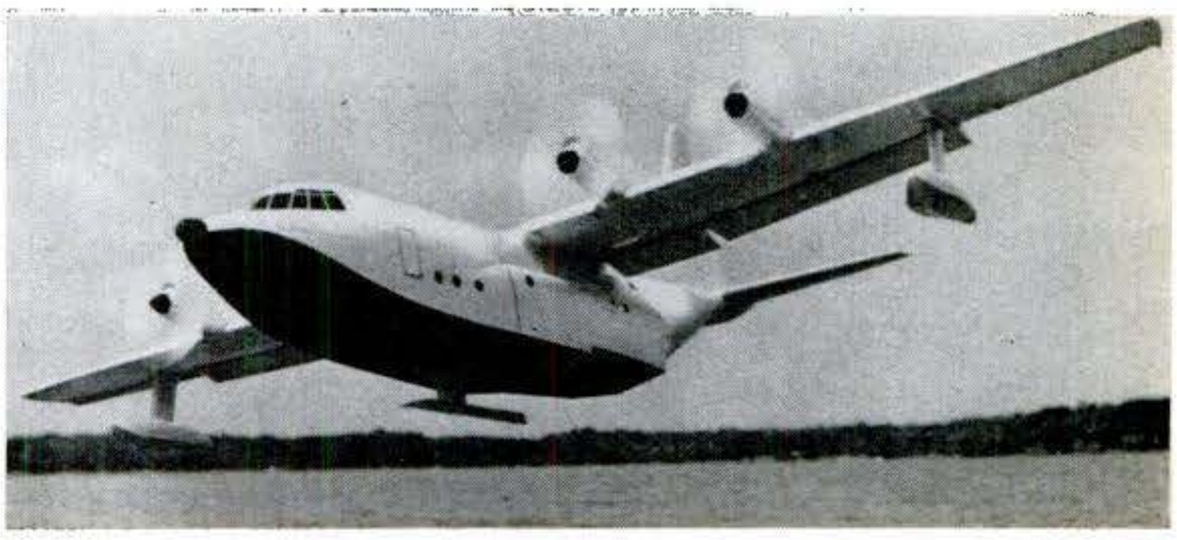
Loud and clear, the EMI (Emergency Medical Instructor) summons assistance and tells what's wrong and what to do. The $145 palm-size tape player is designed for persons subject to certain critical ailments. It's triggered if the wearer falls to a prone or supine position.

One-man trailer

Attach the ToBar to the bumper of your car, roll your motorcycle on, raise the bar, and secure the bike—all a one-man job. The bike tows on its own hind wheel. The ToBar accommodates most bikes, sells for about $85. ToBar Products, 915 Carol, Elgin, Ill. 60120.

STOL amphibian

What this country needs, says the Lockheed-Georgia Co., is an amphibian short-takeoff-and-landing airliner for short hauls between major cities. Their conception (right): a modified L-100 Hercules with engines atop the wings and a retractable hydro-ski under a fiberglass hull.



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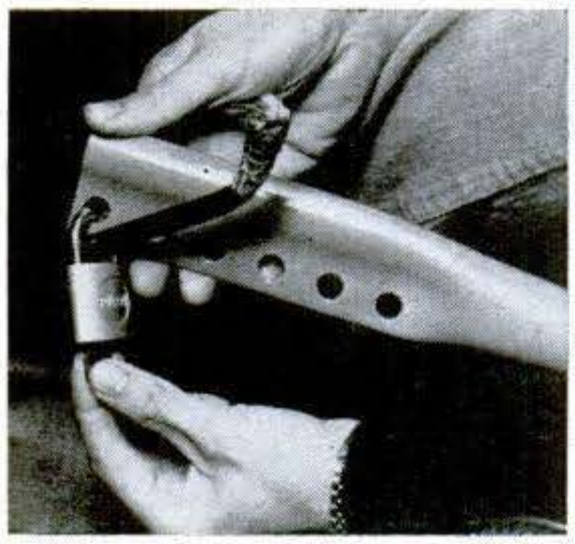
What's New

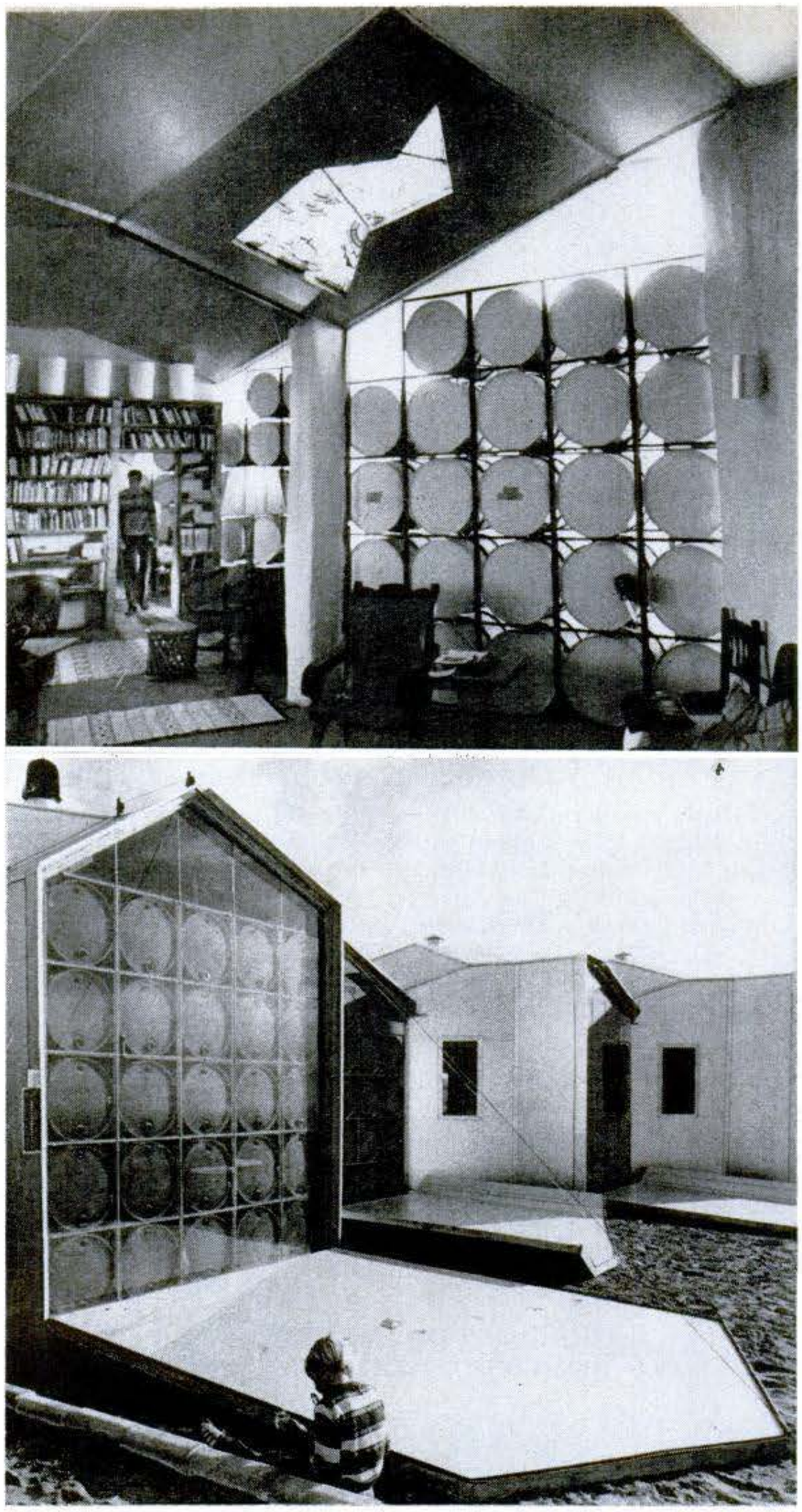


Double lock

Car thieves will stay away from this one: a bright orange steel sleeve that padlocks your car's shift and hand brake. The British-made Brake-N-Gear lock fits any car with between-seat brake and manual transmission. V. C. Saunders, Ltd., 51 Dryburgh Rd., London S.W. 15.

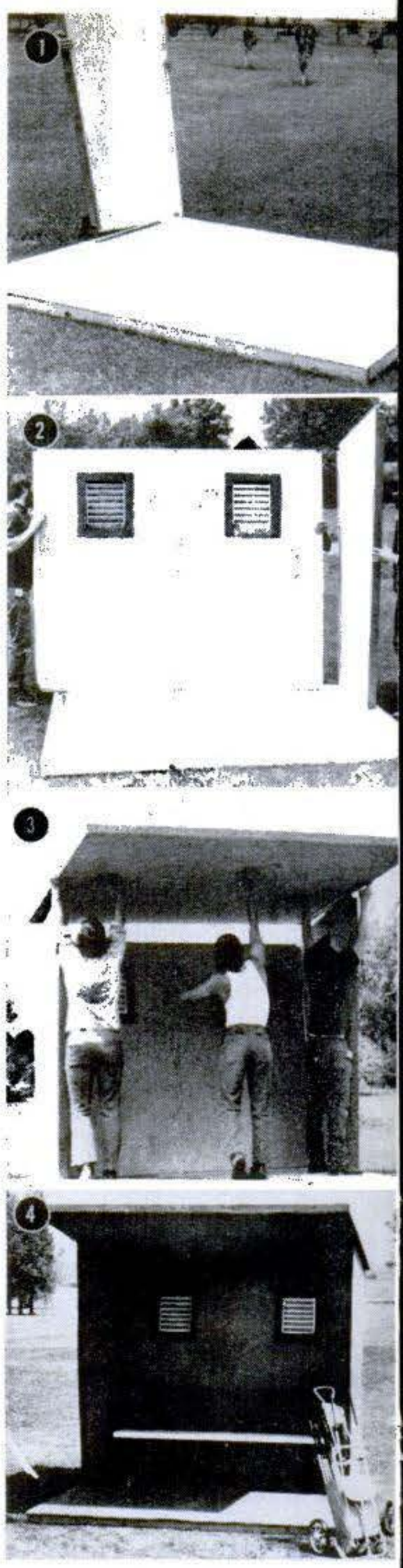
Battery sprayer

No hoses, no cords, no hand pumping—the Rockwell battery-powered sprayer pumps three quarts of fluid on one charge. It's designed for insecticides, fertilizers, herbicides, or other garden liquids. The sprayer holds one quart. Price: $19.99.



He warms his house with barrels of heat

Day and night, solar heat warms Steve Baer's home. The secret: tiers of 55-gallon drums filled with water. By day, four panels on the south side of the house are lowered to expose the black-painted drums to the sun. At night, the panels are drawn up and the warmed drums radiate heat to keep the house comfortable. Baer gets hot water from the sun by means of a solar-heating device, and uses wind power to pump it. The roof and exterior walls of the house, near Albuquerque, N.M., are an aluminum sandwich with a core of three-inch urethane foam. Interior walls are adobe brick—pressed sun-dried mud.



10-minute shelter

Ten minutes is all it takes to erect this golf shelter, says the maker. Pictures above show the sequence. Sections, made of two-inch foam plastic sandwiched between exterior-grade siding, are secured with PVC tubing. Floor dimensions: 88 by 96 in. Standard Mfg. Co., 220 E. 4th St., Cedar Falls, Iowa.

Dog saver

Fido needs protection, too, in case he tires in the water, and here it is: the Doggie Vest. Made of foam flotation material, it comes in four sizes, depending on the dog's chest size (10-14, 14-18, 18-22, and 22-26 inches), sells for $7.95 from Fielding Enterprises, 132 High St., Huntington, N.Y. 11743.

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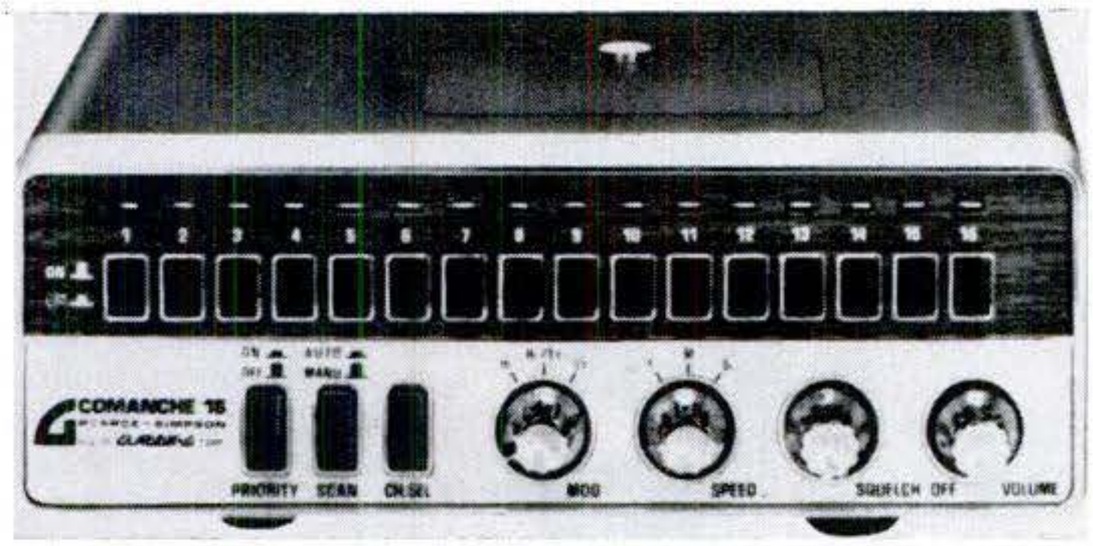
What's New IN ELECTRONICS

Curvy compact

Like the modern touch? Electrophonic's compact Apollo design has it, with curvilinear pedestals for system and speakers. This model has radio, phono, and tape record/playback system for $439.95. Or other components are available. Morse Electro Products, 2777 Summer St., Stamford, Conn. 06905.

Cassette challenge

Teac calls its new 450 cassette deck the Challenger, and invites comparison with any tape machine on the market. The 450 has a 30-16,000 Hz frequency response, a signal-to-noise ratio of 58 dB (with its built-in Dolby), and wow and flutter of less than 0.07 percent. It's $379.50.

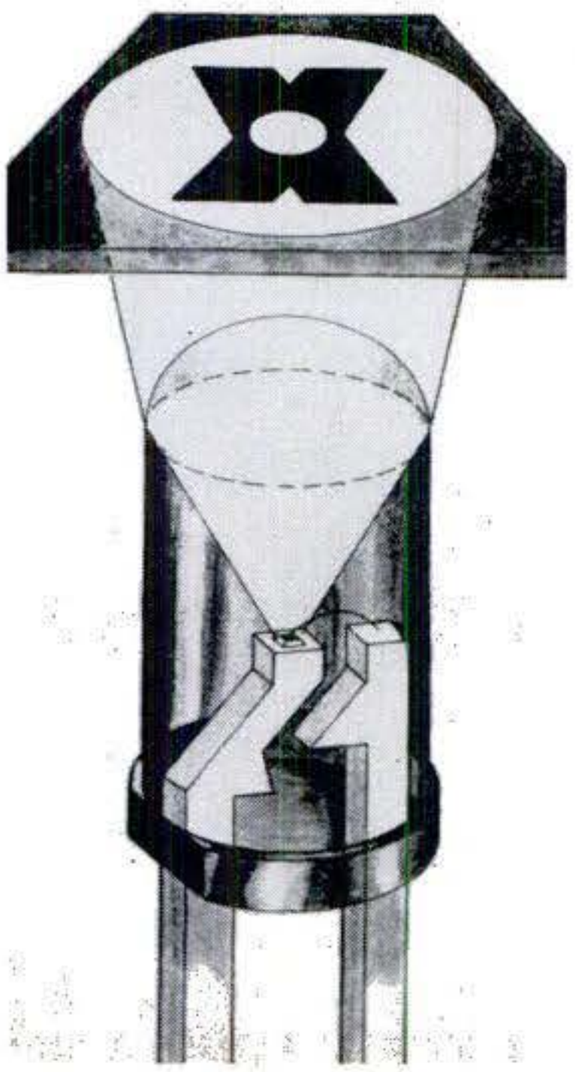


16-channel scan

Top-of-the-line from Pearce-Simpson is this new VHF-UHF scanner. The Comanche 16 has manual or automatic scanning of 16 individual channels, operates from either 115 VAC or 12 VDC. Crystals, inserted through an access door, control frequency. It's $199.95.

Pocket calculator

Radio Shack says its new $89.95 EC-200 pocket calculator can do square roots and exponential calculations besides the four standard math functions. It has a floating decimal, and a hooded display makes easy reading of all eight digits. Comes complete with case and charger/AC adapter.



Brightest LED

A new gallium phosphide LED (left) from Xciton is claimed to be the world's brightest. The drawing shows one illuminating a ¼-inch area of panel. It's the first LED designed to replace the incandescent lamp. The XC554-9 is nine millicandela with only a 10-milliamp draw. Xciton, Latham, N.Y.

See-through radio

You can see right through the new RC-6500 clock radio—and Panasonic wants it that way. Its dials, showing time and station tuning, appear to float in air. Other features: music or "chirp" wake-up alarm, three-inch speaker, external FM antenna. It's $75.

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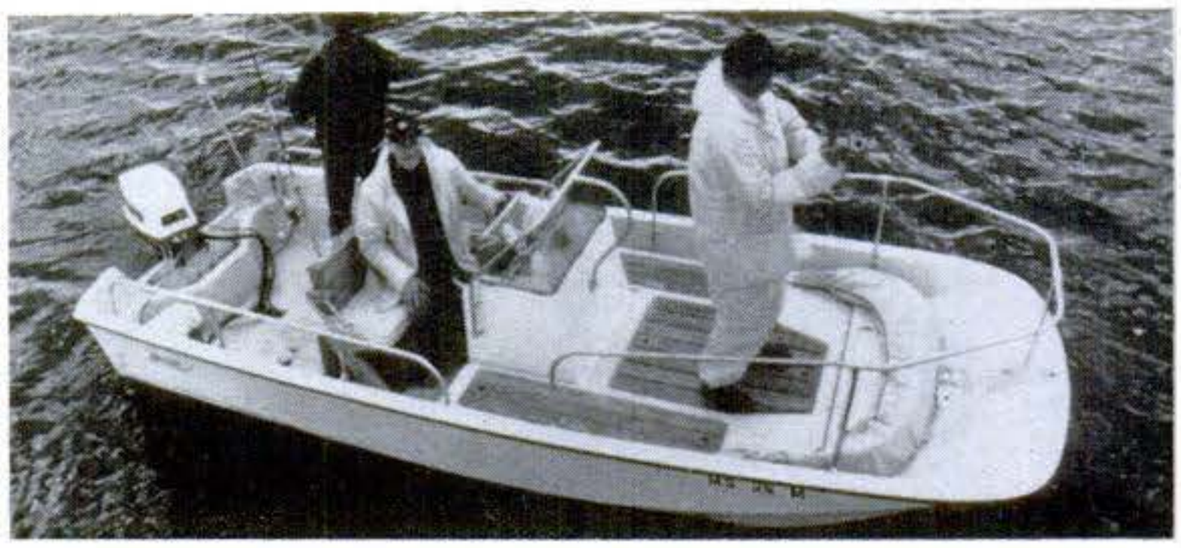
What's New IN BOATING

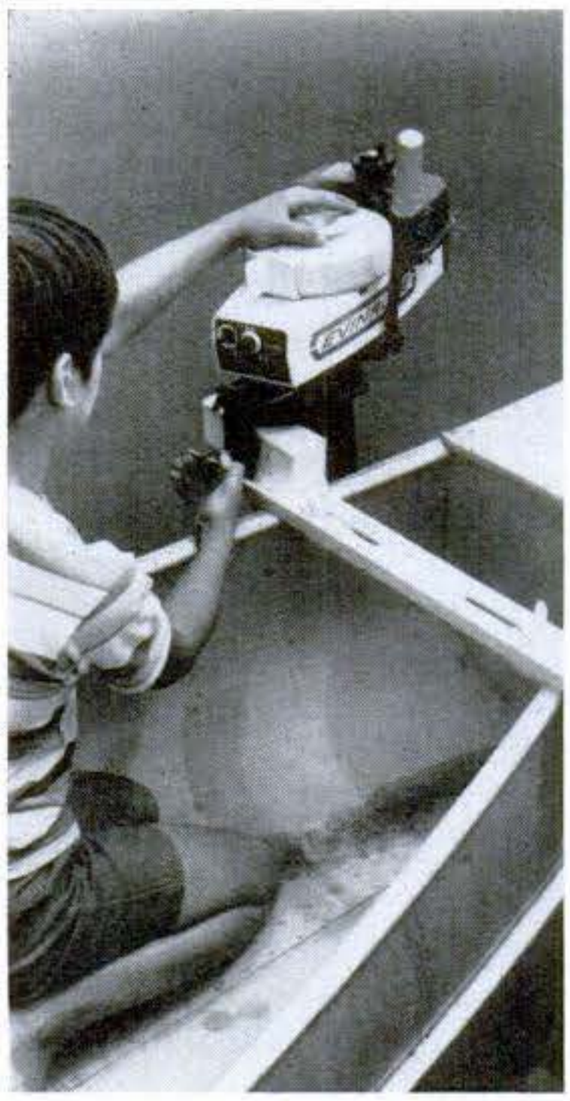
Overnight fisherman

Aquasport 240 is a cuddy-cabin fishing boat. The 24-footer's cabin area features two seven-foot bunks, space for a portable head, and an anchor/line hold. Cockpit gunwales hold teak rod racks. The boat comes as an outboard or I/O, carries a two-year guarantee. Aquasport, Inc., 7925 W. 2nd Ct., Hiahleah, Fla. 33138.



Two new cats for sail or power

Sizzler's gone hot, says the maker. The 16-foot aluminum-hulled, trampoline-decked cat now has more sail area, with a 27-foot mast carrying 210 square feet. She needs no centerboards; her V-hulls keep her from slipping. Standard features include three-position rudders, extendable tiller, foam-filled mast and hulls, and roller-furling jib. Below her is the Smoothie, an 18-foot powered cat with step-down deck. Smoothie's great for fishing—an eight-inch draft lets you sneak into weed-filled shallows. Or you can pull a skier (with a 25-hp motor), or even rig a mast and take her sailing. Price? $1600. Great Lakes Sports Mfg., 5135 Richmond Rd., Cleveland, Ohio 44146.



Day fisherman

Designed for action, the 16½-foot, 770-pound Montauk I has two storage lockers, reversible pilot seat, stainless-steel rails. Lee outriggers attach to a console rail where 15-foot aluminum poles allow fast bow-to-stern movement. Maker: Boston Whaler, 1149 Hingham St., Rockland, Mass. 02370.

Power bracket

Outboard power for your canoe? The Bremer CB-3 bracket offers a way to hook it on. It's designed for port or starboard side, is made of aluminum and stainless steel, comes in white, weighs six pounds. $22.95 from Bremer Mfg. Co., Box 548, Elkhart Lake, Wis. 53020.

Boat bag

Boat sitting out in the open this winter? Bat-A-Boat, a 25-foot-long polyethylene "bag" may be what you need. You open it up, back trailer and boat in, and tie it with a rope. It takes boats on trailers up to 18 feet. Price: $22.95. Maker: Northern Petrochemical Co., 219 Liberty Sq., E. Norwalk, Conn. 06855.

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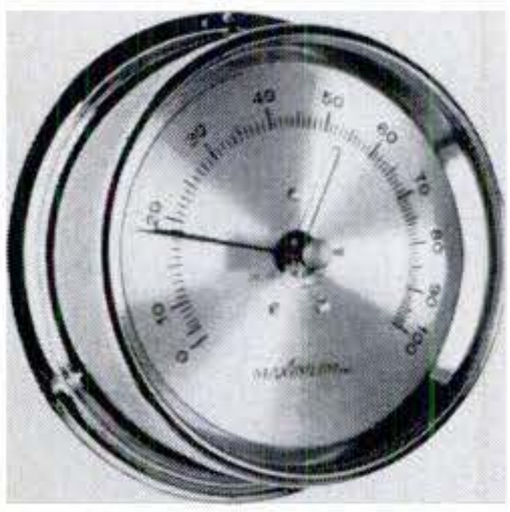
What's New FOR YOUR CAR

Light-up cover

Prop Soc's the name of this I/O cover that protects your engine while meeting "flag" requirements in most states. Made from red waterproof vinyl, it has a built-in red safety light that hooks up to trailer wiring. It's made by PRS Products, 26th & Main, Bismarck, N.D. 58501.

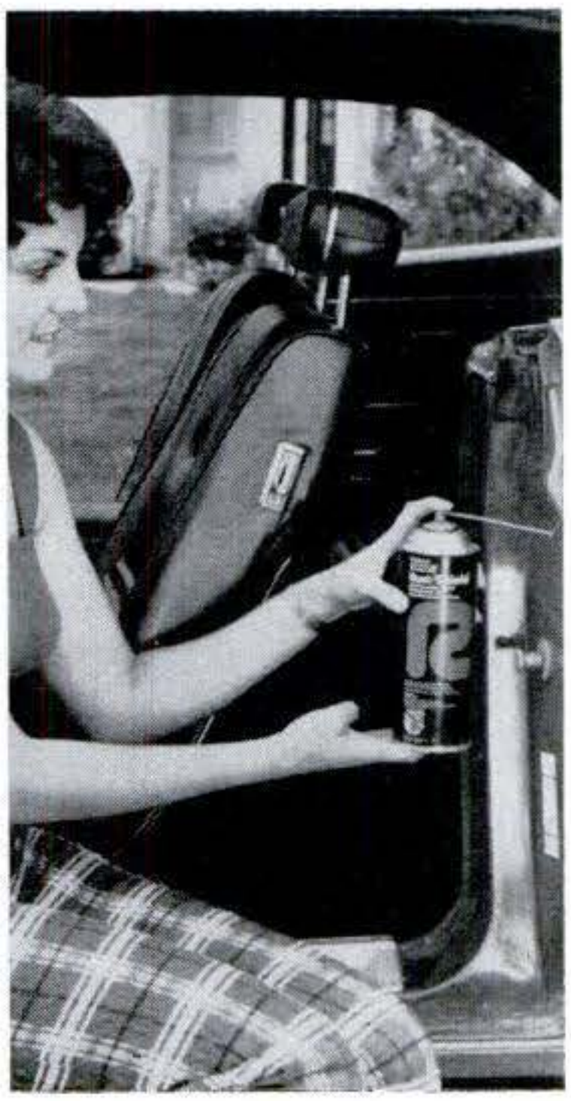


Gust register

Strongest gusts? This wind instrument tells you not only wind speed and direction, but has a gust register that records peak velocity during any period and holds it until reset. Maximum instruments sell for $115 to $215. Maximum, 8 Sterling Dr., Dover, Mass. 02030.

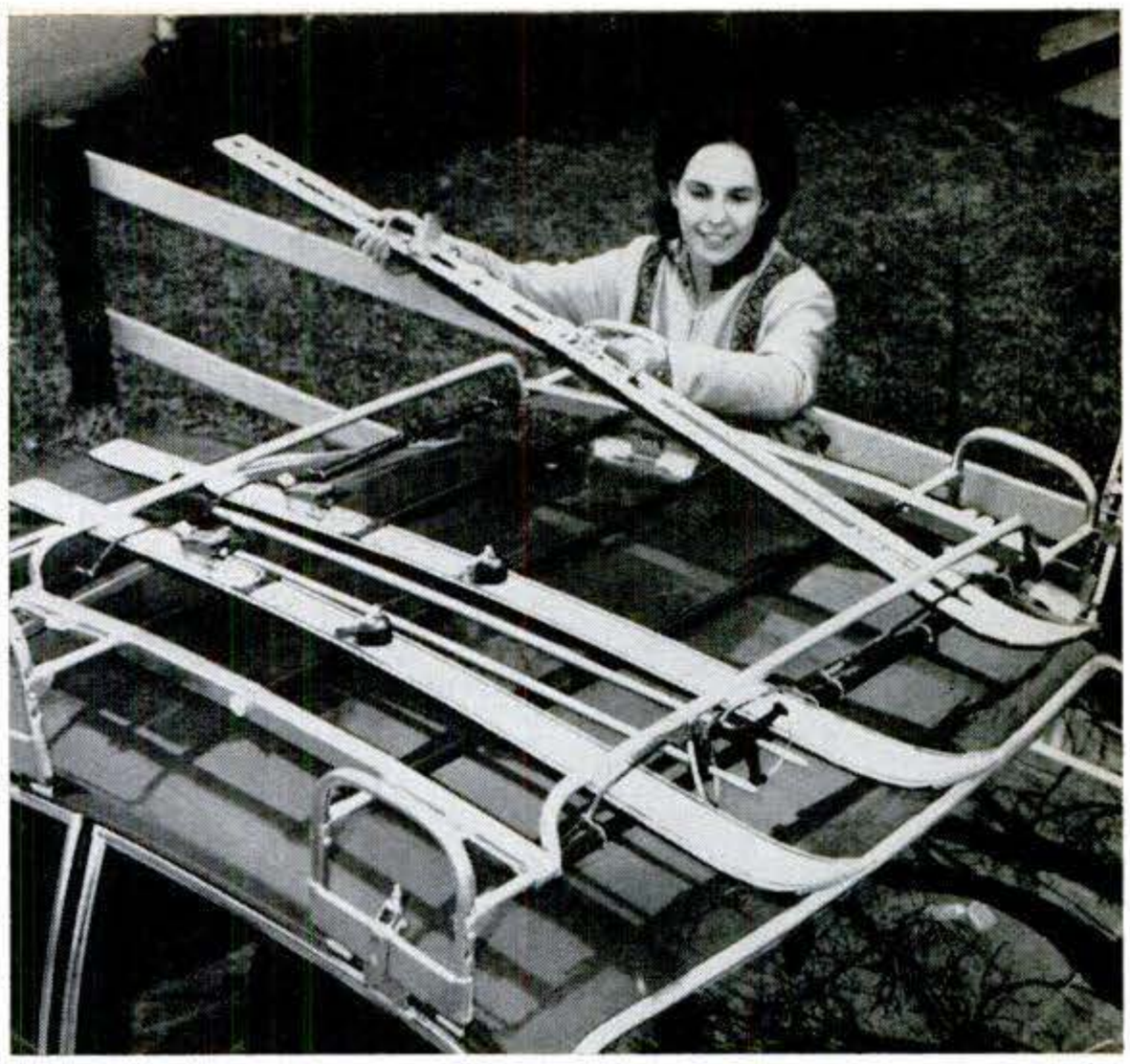
Leak detector

Now you can track down leaks electronically, with the Sonic Leak Detector. A black box (inside boat) puts out an ultrasonic signal. A locator wand (with earphones) receives the sound through the tiniest of leaks. Price: $250. BoatLife, 65 Bloomingdale Rd., Hicksville, N.Y. 11801.



Rustproofing kit

In about three hours you can rustproof your car, saving $65 to $85, claims the maker of Rust/Shield. The kit includes two 24-ounce aerosol cans of antirust compound and a step-by-step instruction book. It's $12.95 from Herrick Enterprises, Box 301, Bloomfield Hills, Mich. 48013.



Fold-away rack

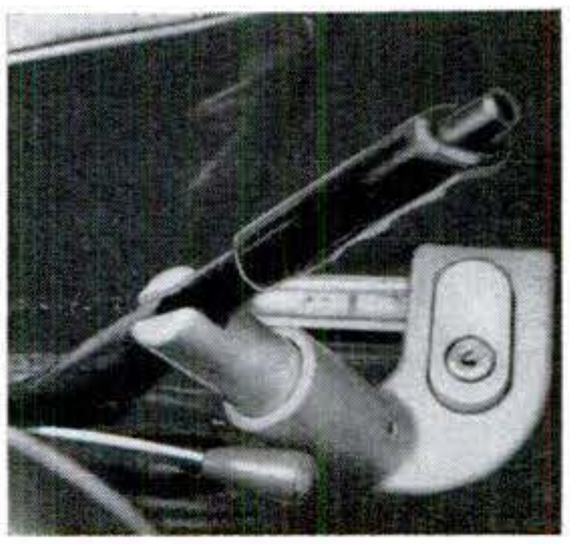
It folds into your car trunk, opens to carry a 440-pound load on the roof. The Hema Exclusive's support legs telescope into the rack, to fit any size car and make it transferable from one vehicle to another. Price: $39.95. Maker: ICM Marine Products, 1140 W. 15th St., N. Vancouver, B.C.

Timing light

Put this new high-intensity timing-light kit together and you can check ignition timing, synchronization of double-breaker arms, automatic spark advance, and distributor-cam wear on your car. A 600-volt flashtube delivers up to 1250 flashes a minute. The Radio Shack kit sells for $19.95.

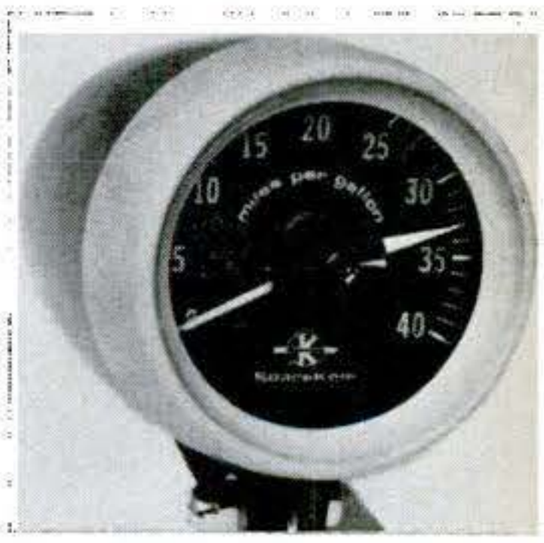
Flyweight rotor

Carbon tracking causes ignition-system failure, says GM, and they've come up with this Delco lightweight thermoplastic rotor to eliminate the problem. The unit fits all GM eight-cylinder external-adjustment distributors (from 1957-1973) and has self-contained screws for quick installation.



Brake lock

Porsches will be harder to steal with this hand-brake lock. It attaches to the track of the driver's seat, and prevents release of the hand brake. It's $49.95 from Brake Sentry, Box 17645, San Diego, Calif. 92117.



Gas meter

What's your gas mileage at any moment? Milomax tells you, enabling you to find the most economical driving speed. Use it, says the maker, and reduce gas consumption by an average of 20 percent. It's $34.50 from SpaceKom, Box 10, Goleta, Calif. 93017.

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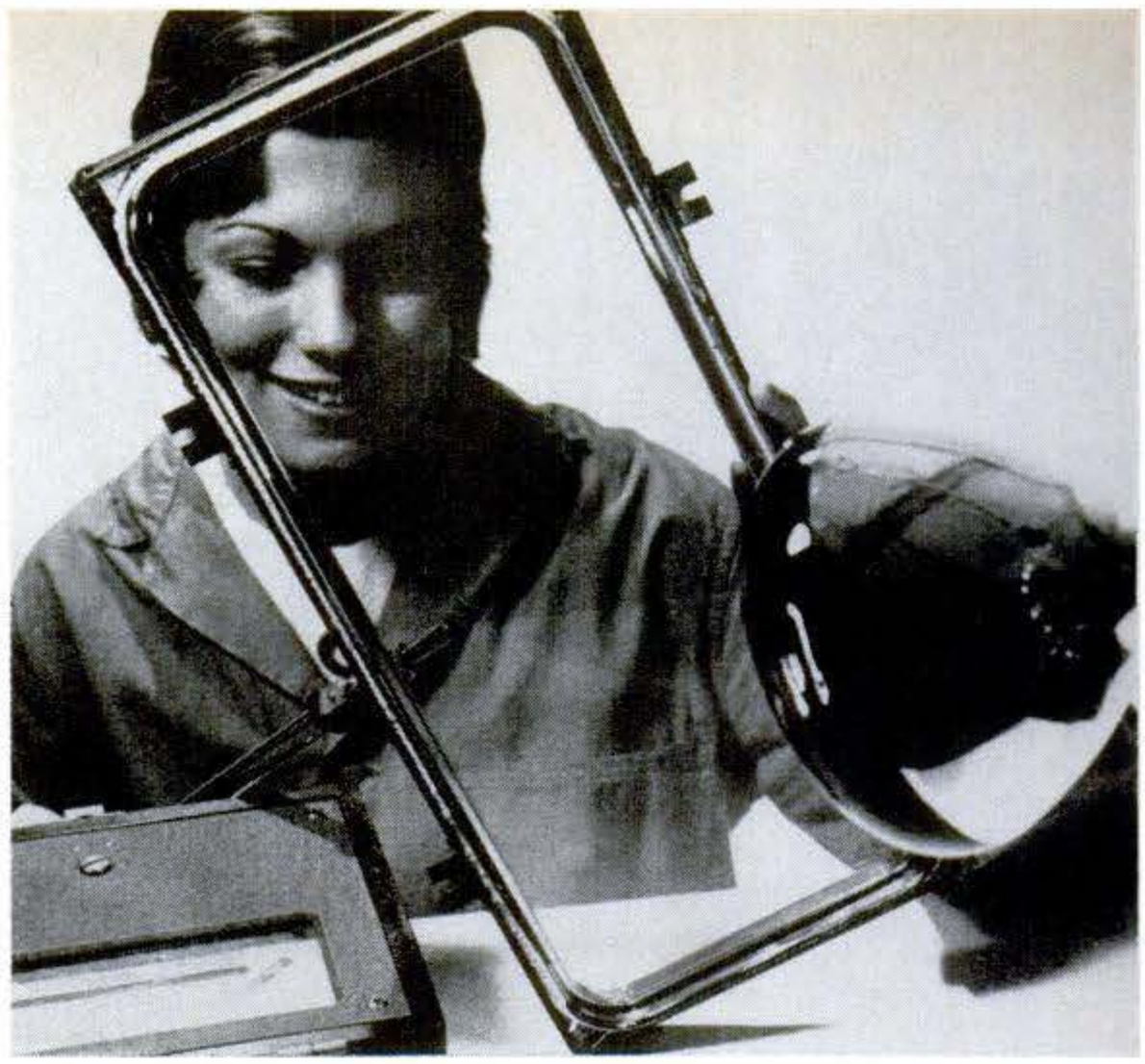
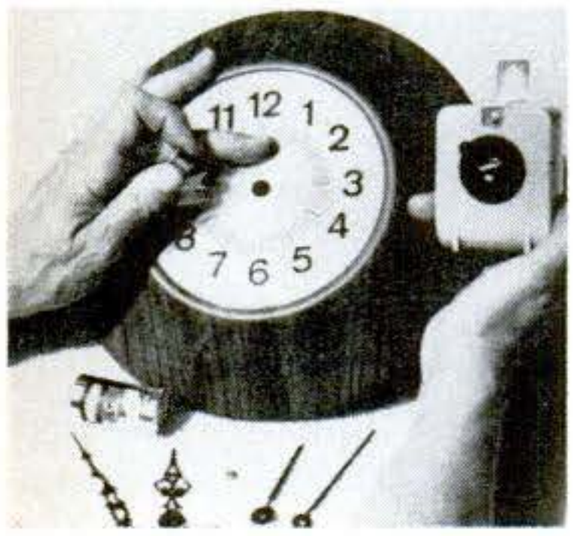
What's New IN HOME IMPROVEMENT

IR stopper

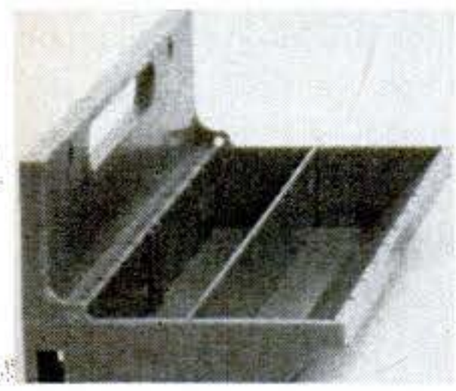
PPG is out to save a watt with a new glass for oven windows. Coated with a transparent metal oxide, the window reflects infrared radiation back into the oven. Result: more heat inside, less outside. The IR-lamp-and-thermometer experiment at right demonstrates the point. The coating won't wash off.

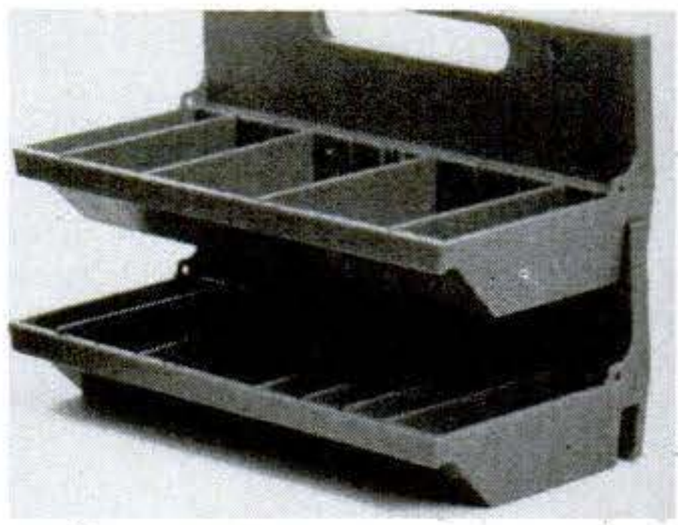


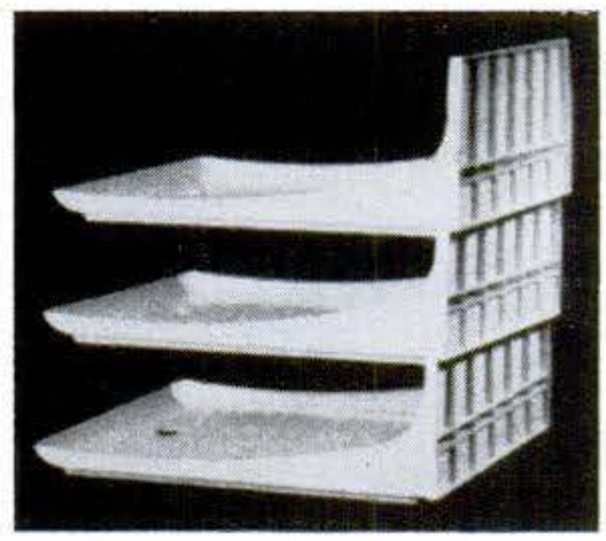


Timepiece saver

Father Time finally get the best of that old heirloom clock? Bring it back to life with a new battery-powered movement. There's a choice of three models priced at $12.20, $15.70, and $63 (quartz model). Custom Clocks, Golden, Mo. 65658





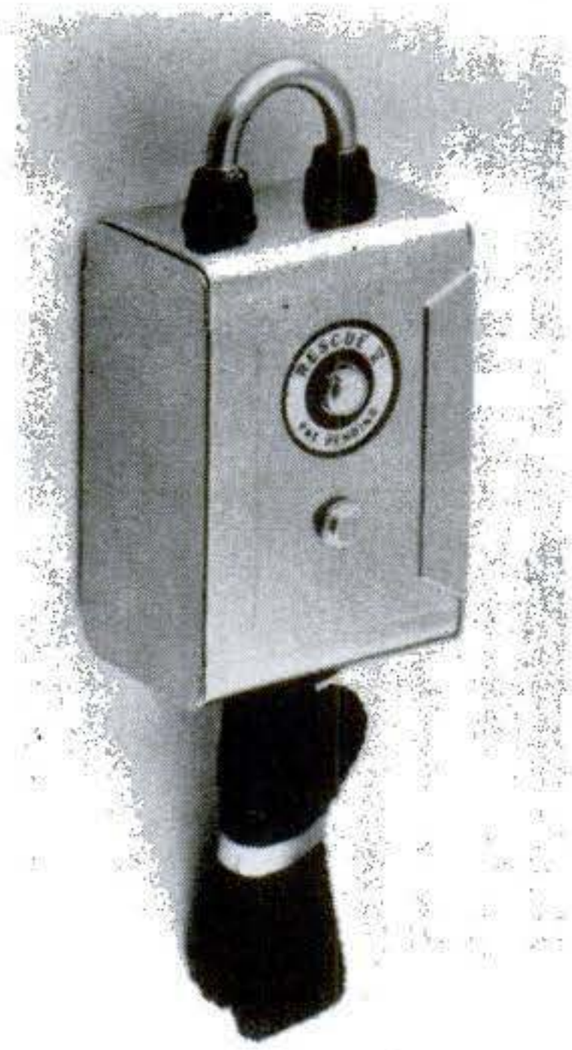


Stacking storage

Small objects, from screws to tape cassettes to office papers, sort themselves out easily in Stac-All stacking trays. They come in a variety of designs, from 69 cents to $4.79, with accessories that include lids and divider sets. Stac-All, 1650 West Big Beaver Rd., Troy, Mich. 48084.

Screw-hiding hook

These multipurpose hooks hide their mounting screws. You screw the bottom section to the wall, then slip the top section in place to hide the screws and add an extra hook. The new Futura 301 hooks are by Gries Reproducer Co., 125 Beechwood Ave., New Rochelle, N.Y. 10802.



An extra dimension in ceilings

Armstrong's new Tegular suspended ceiling combines the look of fissured marble with a recessed black gridwork that adds an element of depth to your overhead environment. Despite its marble appearance, the ceiling soaks up sound. Mineral-fiber construction makes it fireproof. Like other Armstrong suspended ceilings, Tegular will take Gridmate and Troffermate lighting fixtures, and installation is simple enough for the homeowner to tackle it on his own.

Easy exit

Upstairs escapes from burning buildings are a snap with Rescue V outside your window. Grab the handhold and step out the window. A steel cable lowers you to the ground at about four mph, from any height up to three stories. Rescue V is $15.95 from Southfield Products, Box 632, Glen Cove, N.Y. 11542.

Chameleon fixture

Colored tubs are nice, but how do you choose a color you can live with for 20 years? Owens-Corning figures you can't, so they've come up with a new line of tub-showers with interchangeable color panels. Decide to repaper or paint the bathroom? Just change the panels. No tools are required.

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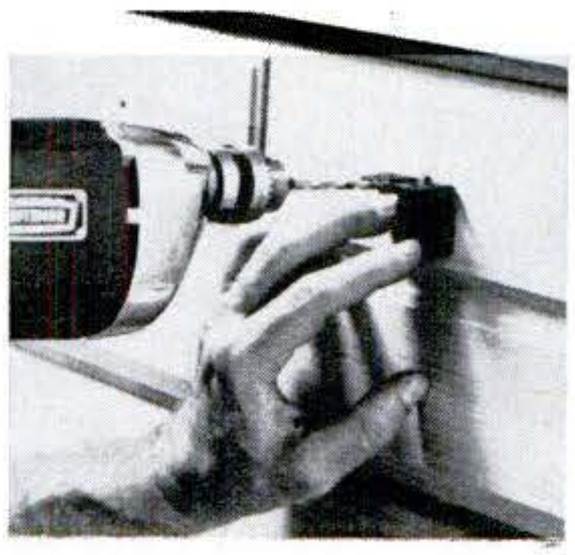
What's New
IN TOOLS

Two-faced safe

A safe may protect your money, but it sure can be ugly. Enter: new line of walnut-finish cabinets with a Sentry safe inside. Outside, they come in traditional, mosaic, and contemporary styles. Prices start at $160. John D. Brush Co., 900 Linden Ave., Rochester, N.Y. 14625.



Do-all drill

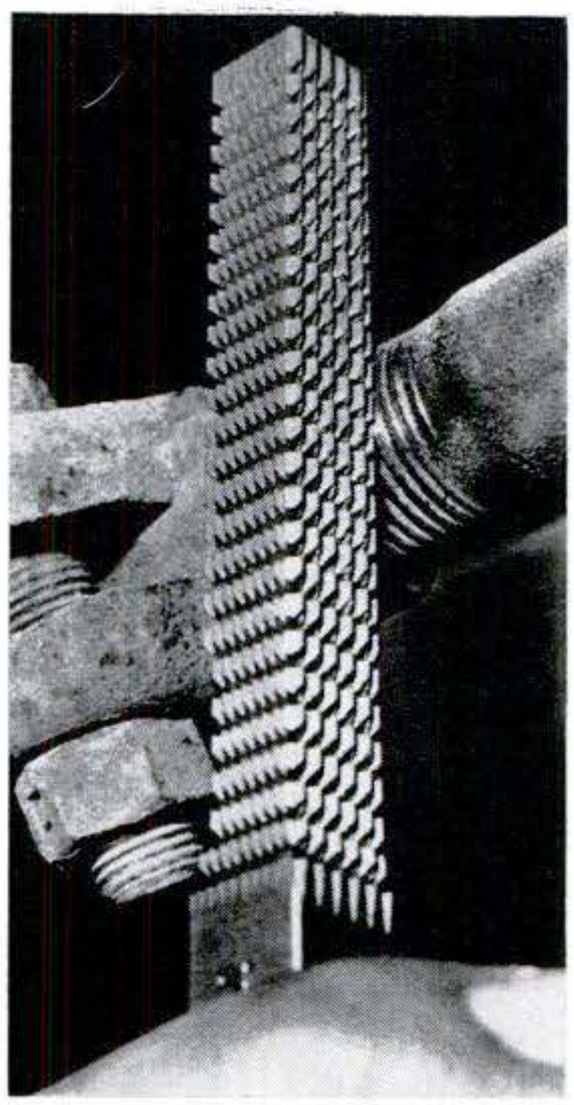
Sears Craftsman Type One ⅜-in. drill is designed for versatility, with variable speed and a reverse gear. Above, it's being used with a new Craftsman hole square and drill index, which serves both as a 90-degree drill guide and a bit-measuring tool. The drill is $39.50; index, 49 cents.

Two-way readouts

To help ease your transition to the metric system, this mike gives you metric readings on the digital counter, English readings on the thimble. (Or you can get 'em reversed.) The Combimike 0-1 is $36.50. G & G Precision Tools, Box 757, Albuquerque, N.M. 87013.

Brighter bulb

More glow on less juice? That's what Duro-Test says about their new WattSaver bulb. By using krypton instead of argon, a 92-watt WattSaver will shed light equal to an ordinary 100-watter of the same life-span. The long-life bulbs come in 55-, 92-, and 138-watt sizes.

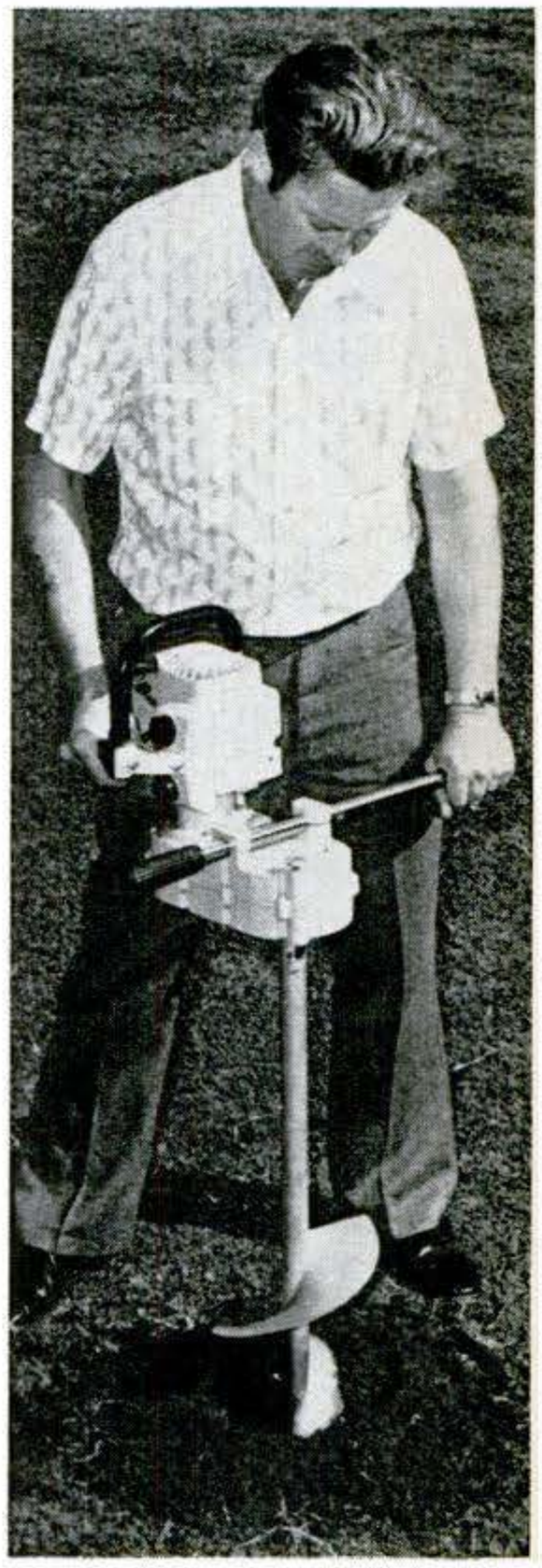


Thread fixer

With metric threads coming in fast, you may need a metric thread file. Here's the Nu-Thred file. It can repair left- or right-hand thread in eight pitch sizes. Use it as a thread gauge, too. Jaw Mfg., 39 Mulberry St., Reading, Pa. 19603 makes it.

12-volt drill

Camper or boat—anywhere you have 12-volt current—you can bore a hole with Versa-Drill. The ¼-inch drill comes with a 12-foot cord and battery clips. For torque, it has 25:1 gear reduction. Versa-Drill is $14.95 from Dick Cepek, 9201 California Ave., South Gate, Calif. 90280.



Earth auger

McCulloch took the engine from their popular Mini Mac chain saw and hooked it to an auger through a two-speed gear box. Result? Fast post holes. It weighs 23 pounds, sells for $270 with a one-inch wood auger, 30 inches long. Big augers like the one above will cost you extra.

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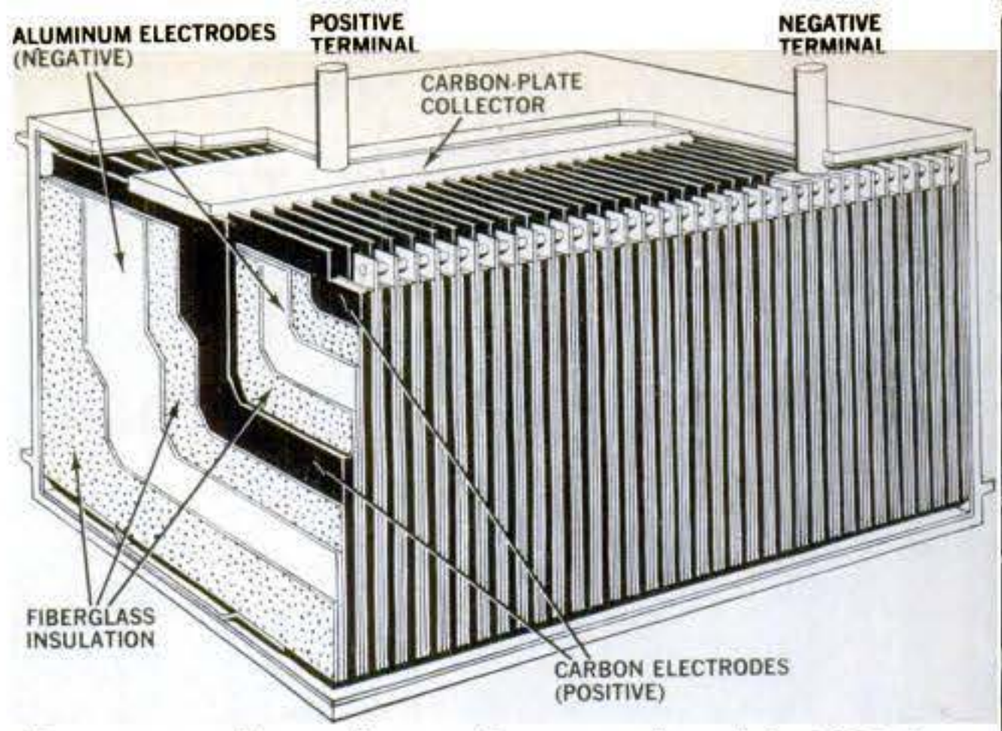


Porous-carbon electrodes are placed in ESB Inc. high-temperature test battery by Dell Crouch Jr. Each electrode, with one-million sq. ft. of surface area, stores electric charges like a giant capacitor. Battery works only when its fused-salt electrolyte is melted (400 degrees F) with heating pads. A future 5-by-4-by-1-ft. version for electric-utility substations would have built-in heaters. It could deliver 10 kw for up to 10 hours during the day, recharging during off-peak hours.

To help relieve the energy crunch...
SUPERBATTERIES

They'll store electric power using molten salts hotter than your oven. And they pack the wallop needed for electric vehicles

By JOHN R. FREE ILLUSTRATIONS BY RAY PIOCH

Peering at the pocketsize electrical-storage cell inside the "glovebox," I reached in gingerly and picked it up. The prototype lithium-sulfur cell was housed in a stainless-steel disk five inches in diameter and 1.3 inches thick. Had the cell been active, I would have dropped it like a hot steel rivet: Its *normal* operating temperature is a sizzling 700 degrees F. Compared to lead-acid batteries of similar weight, though, lithium-sulfur devices can deliver up to seven times the power—and last up to 100 times longer on a single charge.

This superpowerful cell is under development at the U.S. Atomic Energy Commission's Argonne National Laboratory near Chicago. My gloved hand was inside a helium-atmosphere glass-enclosed box. These gloveboxes, like rows of huge fishtanks with ports fitted with gloves, enable scientists and technicians in Argonne's Chemical Engineering Division to work on cells under moisture-free conditions. Powerful chemicals used in the cells, called fused or molten salts, quickly soak up moisture from the air.

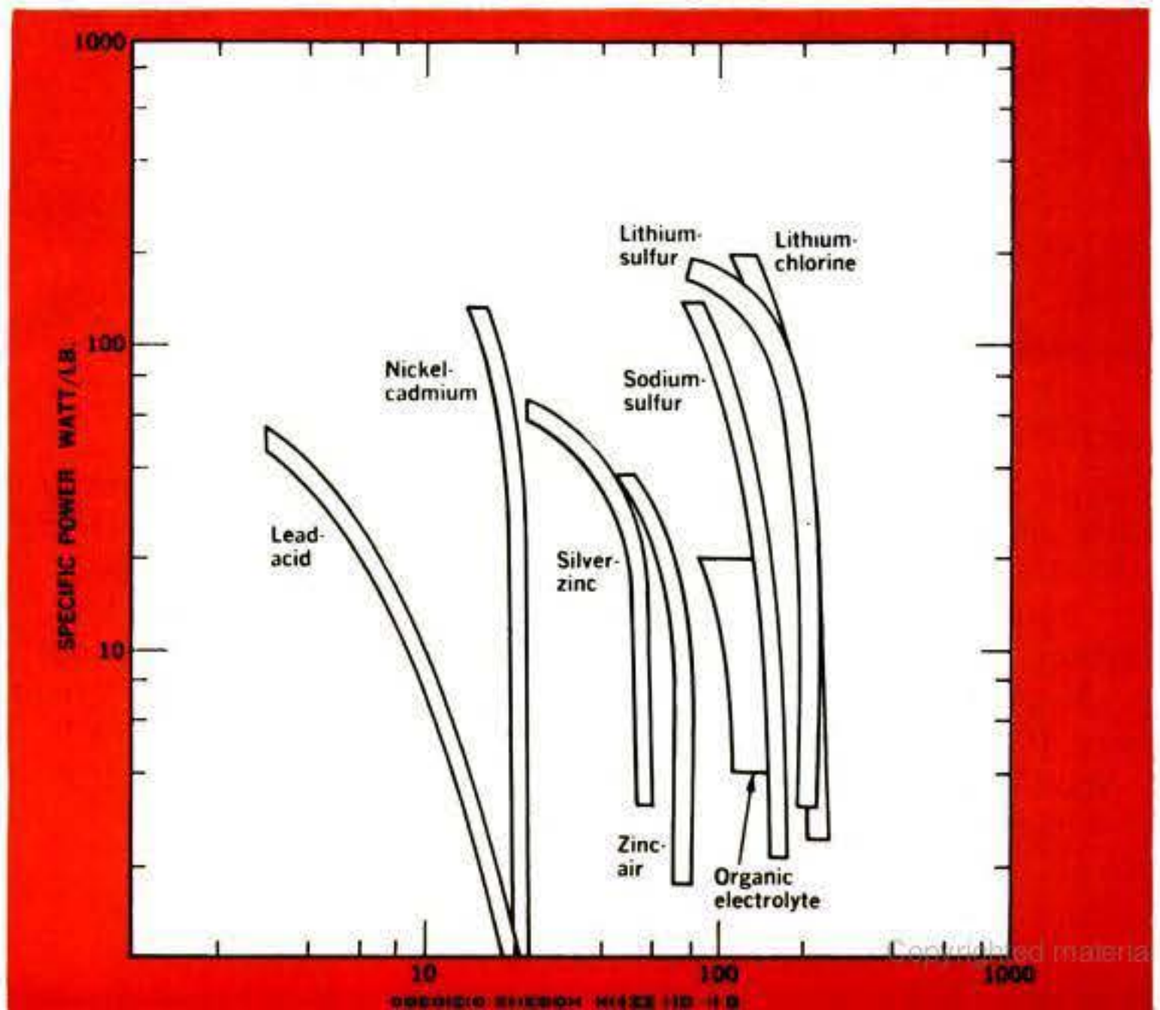
Earlier, at the Yardley, Pa., Technology Center of battery-manufacturer ESB Inc., I saw a different approach to high-temperature storage batteries. ESB's battery, one-third of a test module, was in a 17-by-7-by-13-inch Teflon-lined aluminum case (photo). It requires far more space to match the wallop of Argonne's superpowerful cell, but uses cheaper materials and runs at a "cooler" 400 degrees F. This battery uses highly porous carbon plates to store electrical charges. Amazingly, a sugar-cube-size chunk of this carbon has an effective surface area of 120 by 120 feet.

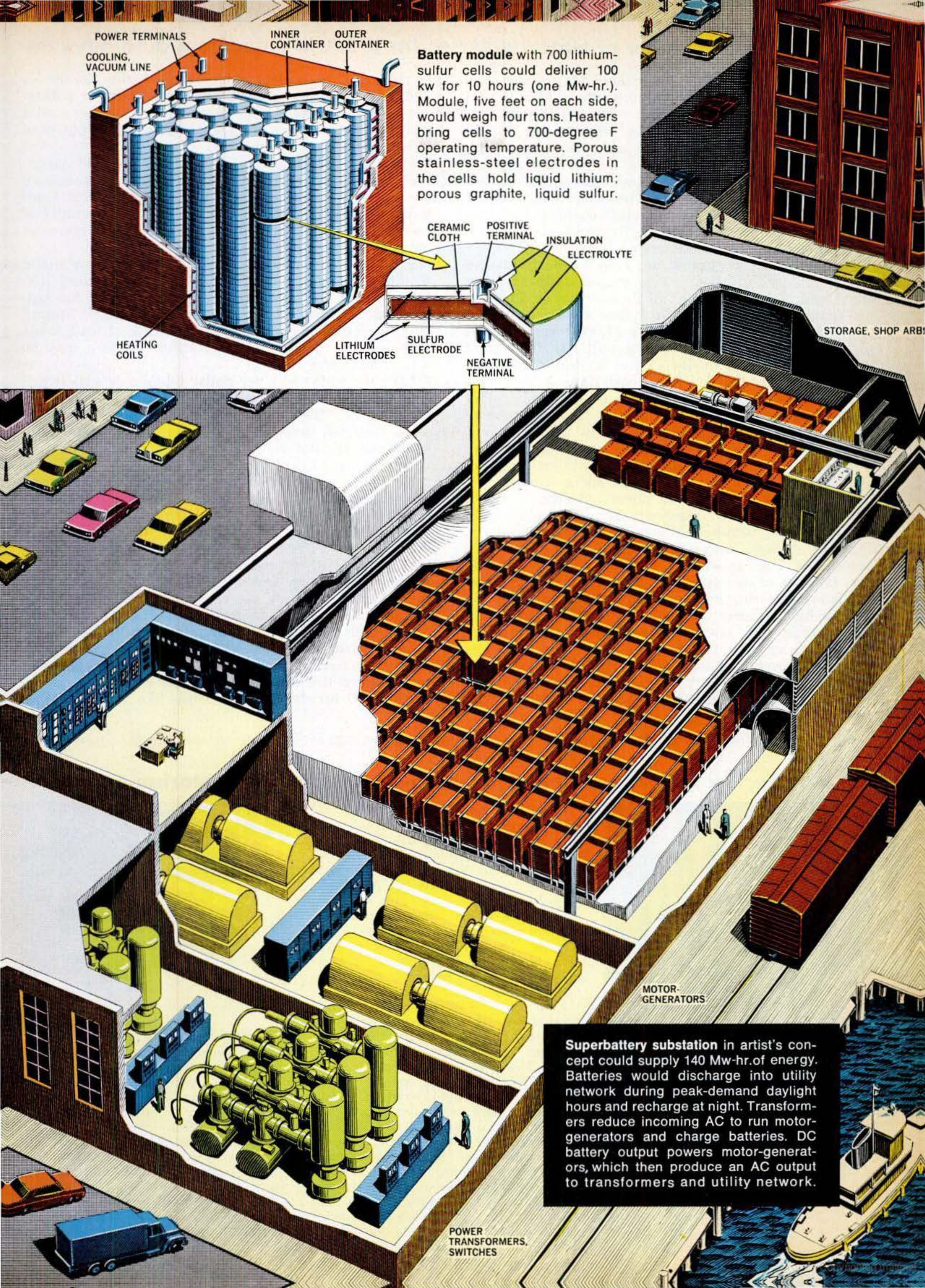
Storing energy while you sleep. ESB, Argonne, and others are developing special high-temperature batteries that electric utility companies could use to "level" their generation loads. Such superbattery systems, planned for the 1980s, would be scattered throughout urban areas at distribution substations. Batteries would

Continued

How cells compare in power and energy

Curves show the power and energy characteristics of laboratory cells. Specific power, in watts/lb., indicates how much power cells deliver per unit weight. Specific energy, in watt-hr./lb., shows ability to do work per unit weight.





Battery module with 700 lithium-sulfur cells could deliver 100 kw for 10 hours (one Mw-hr.). Module, five feet on each side, would weigh four tons. Heaters bring cells to 700-degree F operating temperature. Porous stainless-steel electrodes in the cells hold liquid lithium; porous graphite, liquid sulfur.

Superbattery substation in artist's concept could supply 140 Mw-hr.of energy. Batteries would discharge into utility network during peak-demand daylight hours and recharge at night. Transformers reduce incoming AC to run motor-generators and charge batteries. DC battery output powers motor-generators, which then produce an AC output to transformers and utility network.

"Widespread use of superbatteries for electric vehicles would have an

be charged at night, when power demands are low; during peak-demand daylight hours, they would feed power to a city—noiselessly and without pollution.

Using superbatteries this way, experts say, would help conserve both fossil fuels and the environment. Some 20 laboratories throughout the world, including Argonne, are also developing superbatteries for electric cars, trains, and buses. The widespread use of superbatteries for electric vehicles, coupled with nuclear power plants to charge the batteries, would have an enormous impact in conserving fossil fuel.

Here's how superbatteries may help the electric-power industry: Most utilities face enormous daily and seasonal load variations. On a hot summer day in Chicago, for example, Commonwealth Edison's load gradually climbs to a midday peak of over 11,000 megawatts. At night demand drops to 6000 megawatts. Utilities can't build large, efficient fossil-fuel and nuclear plants that would be used only a few hours each day.

Instead, as the daily demand for power climbs, older plants, that use fuel less efficiently, take on more of the load. As demand peaks, small but noisy gas turbines and oil-fired diesels—called "peakers"—go on line. Some utilities also call upon their pumped hydroelectric storage, the only important energy-storage system in use by utilities. In these systems, water is pumped into elevated reservoirs at night; released, it flows downhill, turning turbines to generate electricity. Pumped storage, however, represents less than three percent of U.S. generating capability planned or in use. Because of its environmental impact, pumped storage is encountering increased public opposition.

Now, high-temperature molten-salt batteries may offer a promising new energy-storage system for utilities. Superbatteries would reduce the need for fossil-fuel "peakers;" overall energy costs could be lowered by storing cheap electricity from large, highly efficient plants. Ideally, superbattery power substations would be recharged by nuclear plants, representing the lowest fuel costs. Another benefit: With superbattery substations spread throughout urban areas, utilities could trim transmission-line costs, since they would not have to be sized to carry peak loads.

Until superbatteries, with their high specific energy (see chart), showed promise in the labs, batteries were economically impractical for utilities. A typical load-leveling battery system might deliver 14 megawatts of energy and supply a utility network for 10 hours or more (a 14-megawatt system).

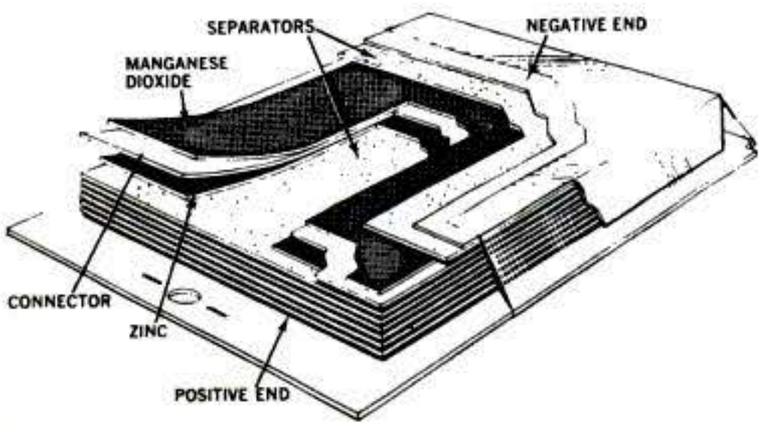
Lead-acid batteries for utility power systems would require enormous stacks. To achieve the desired lifetime—five to 10 years or more—lead plates for batteries would have to be very thick and costly. Storing one kilowatt-hour could require $8 worth of lead, while raw materials for a high-temperature battery may be a fraction of this cost.

"It's the watt-hours per dollar that's a crucial item," says John Werth, manager of ESB's Power Technology Department. "The other crucial item is the life," he adds. "It's not very difficult to get low cost per kilowatt hour. It's not too difficult to get long life. But it's very very hard to get both in the same battery."

Building a cooler battery. Werth showed me one prototype battery using low-cost materials at ESB's Yardley Technology Center. Under wraps, however, because of pending patents, was an improved design. This may be a "cooler" battery, a goal in most high-temperature-battery research. "There's a tremendous economic advantage to working at lower temperatures," says Werth. "You can use cheaper materials, the same material will last longer, and you need less insulation."

The ESB prototype I saw operates at 400 degrees F. "Cooler" batteries must still be hot enough to keep their molten-salt electrolytes in liquid form. At room temperature the salts solidify. The elevated temperatures speed up chemical reactions—like heating chemi-

New batteries: flatpacks, lead-acid Ds, 15-minute ni-cads, chlorine power



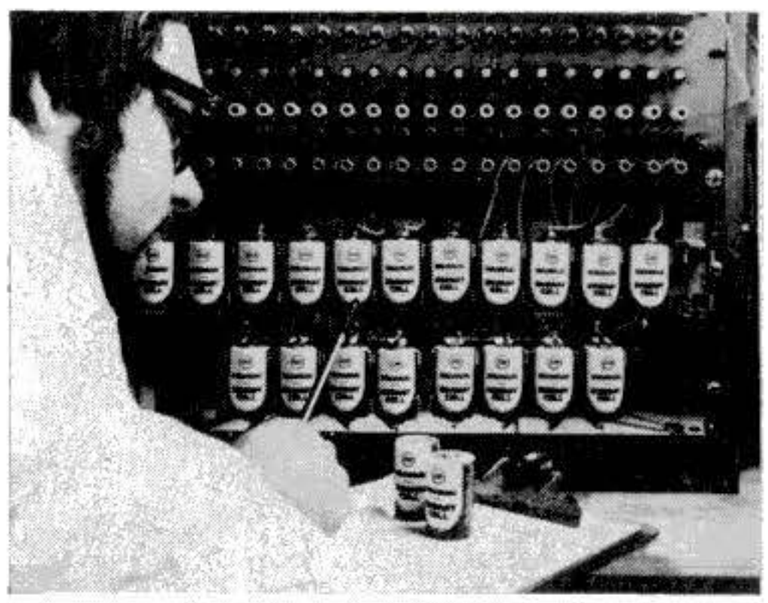
Flatpack for a Polaroid

The hottest new battery on the market this year is Polaroid's Polapulse. This unusual six-volt flatpack was developed by the Ray-O-Vac division of ESB for Polaroid's new SX-70 camera [PS, Jan. '73].

Polapulse powers the camera's film-ejection motor, exposure, and flashbulb circuits. You get a fresh battery with each film pack. It measures approximately 3½ by 2¾ inches and less than ⅛-inch thick.

Four flat 1.5-volt cells, made like printed circuits, are stacked on top of each other. Battery layers are bonded together to minimize electrical resistance. The steel top sheet, which forms the battery's negative end, is undercoated with zinc, and is wrapped around the bottom card so the minus and plus contacts are on the same side. Beneath the steel sheet is a separator, followed by a triple-layer sheet—a conductive connector top-coated with manganese dioxide and bottom-coated with zinc.

The first cell is composed of the top sheet's zinc layer, a separator, and manganese dioxide on the triple-layer sheet. An overwrap insulates the battery.



Lead-acid D cell

Undergoing a laboratory test above is a new type of maintenance-free, lead-acid D cell that may soon be in stores for sale to consumers.

Each six-oz. cell produces two volts and has an energy density of 13 watt-hours per pound. The cells have a 2.5-ampere-hour capacity at 300 mA, and can be recharged to 80 percent of capacity in six hours.

There is no need to add water to the cell; it's sealed except for a one-way gas-relief valve for abuse charging. ESB Inc., the developer of the cell, ex-

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enormous impact in conserving fuel"

cals in a test tube over flame. Also, the molten salts offer far less resistance to current flow than ordinary electrolytes.

High-porosity carbon plates. Reaching into a glovebox, I picked up a beaker of coffee-colored liquid from a hot plate. This was sodium chloroaluminate—a compound of sodium chloride and aluminum chloride—used as an electrolyte. Then engineer Dell Crouch Jr. handed me a slab of high-porosity carbon, the battery's positive electrode. This material stores chloride ions like a giant capacitor as the battery charges. Werth did some fast calculations. The eight-ounce slab, he told me, had an effective surface area of 1/25 square mile. Aluminum plates serve as the negative electrodes.

The overall reaction consists of aluminum ions coming off the negative plates, going into and out of solution, and chloride ions moving to and from the carbon. "Both reactions are highly reversible," says Werth. "There are no solid-to-solid transformations that cause failure of zinc and lead batteries." Cost of raw materials? Less than 50 cents per pound, ESB calculates.

For a 10-megawatt substation, Werth estimates that ESB's batteries would be desk-top size and about one foot high. Some 1000 batteries, stacked 10 to 15 high, and each delivering 10 kilowatts, would be required.

ESB's research has been partially funded by the Edison Electric Institute, a national trade association, which has also sponsored General Electric, Rockwell International, and TRW Systems studies.

The Argonne National Laboratory began high-temperature-battery research in the early 1960s, and has been funded by a variety of agencies since. This year Argonne has $1 million in AEC and National Science Foundation funds for separate research programs on off-peak energy storage and electric vehicle propulsion.

Lithium-based cells have been in the spotlight at Argonne since 1969. The earth's lightest solid element, lithium weighs just 1/20 as much as an equal volume

Lithium-sulfur cell is inside helium-atmosphere box to keep moisture from cell's chemicals. Author reaches through glove port, watched by Martin Kyle of Argonne.

of lead, but with the right positive electrode can generate up to eight times as much electricity. Lithium's low weight, plus the ease with which it surrenders electrons (low electronegativity), makes the alkali metal an excellent candidate for high-energy, high-power batteries. Combined with high-electronegativity materials—chlorine, fluorine, sulfur—lithium yields higher cell voltage because of the gap in electronegativities.

Prices for new primary cells using lithium, just being introduced to the consumer market [PS, May '73], in part reflect the cost of lithium: about $8 a pound.

Dressed for the lab area. Before entering at Argonne, I had to slip plastic throwaway slippers over my shoes and clip on a radiation dosimeter; in nearby labs, experiments are being conducted with radioactive substances. Wires from rows of seven-foot-high gloveboxes in the labs feed data from test cells to a minicomputer, greatly speeding research. Lifting an electrolyte solution—lithium chloride and potassium chloride

[Continued on page 148]

pects more than 100 cycles from its new power pack.

The low cost of lead-acid systems might make the cells an attractive alternative to expensive nickel-cadmium batteries. Configurations other than D cells may also be marketed.

Fast-charging ni-cads

Ever need a really fast charge on your portable garden and power tools, photographic or other hobby equipment? You'll be able to charge the newest battery-powered hardware using General Electric's new Powerup-15 system in just 15 minutes.

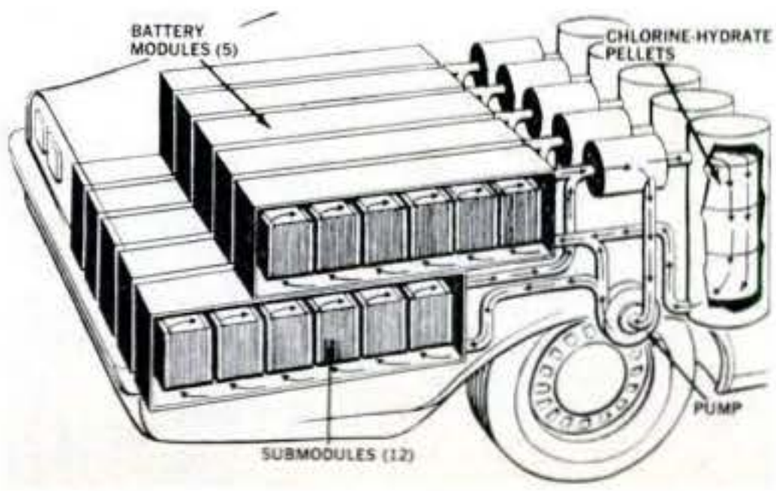
Just introduced for manufacturers (not the consumer battery market), this rapid-charge nickel-cadmium battery system has a new charge control that automatically terminates fast-charge current. The system, sensing both battery voltage and cell temperature, triggers a cut-off switch in the charger when either reaches a predetermined limit. The 15-minute charge brings a battery up to 90 percent of its capacity. A two-hour topping charge at a reduced rate follows.

Each battery pack has three wires coming from it: two for voltage and a third for either a thermistor or thermostat buried in the battery pack. GE is making the Powerup-15 in ratings from 100 mA-hour to 3.5 A-hour.

Running on chloride power

Chlorine's great affinity for electrons (high electronegativity) makes it a superb candidate for battery cathodes (positive electrodes). But its highly toxic nature makes it tough to handle and store—especially in an electric car. Now a zinc-chloride battery system using chlorine hydrate, a safe, ice-like material formed by bubbling chlorine through water, has been developed by Udylite Co. and brightened prospects for a low-cost electric-car battery with a high energy density.

The hydrate, a brilliant yellow solid, provides a chlorine-storage density of



30 lb. per sq. ft. compared to 0.2 for chlorine gas at atmospheric pressure. Hydrate pellets are stored in tanks and chlorine is released into solution when warm electrolyte is pumped over the pellets.

In the modified Vega Hatchback test car, five battery modules, each containing 12 submodules, were used. Each module pump circulates the electrolyte through the zinc-carbon electrodes of each 24-cell submodule, providing the discharge reaction. During charging, zinc replates the electrodes, and chlorine is recovered by cooling the electrolyte and reforming a hydrate.

Performance was impressive: 150 miles at 50 mph; acceleration was 0-40 mph in 10 seconds. Battery weight was about one ton, and considerable development will be necessary to perfect a practical system.

Heavy-duty cell

Ray-O-Vac calls this one a super cell, and says it delivers up to twice the life of conventional zinc-carbon C and D cells. The key, says ESB (the parent company), is the removal of ammonium chloride, which lowers the efficiency of other zinc-carbons, from their new heavy-duty cell.

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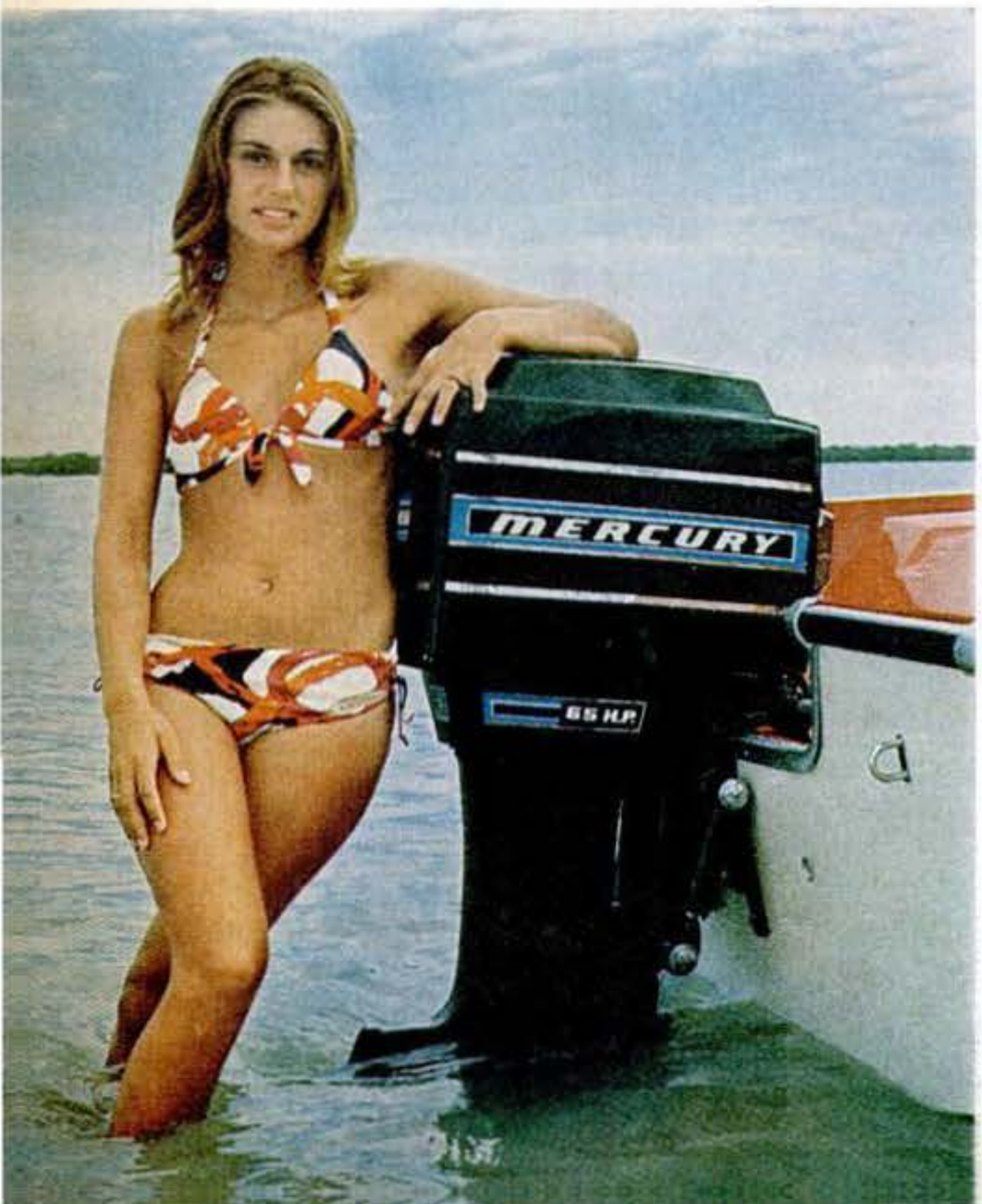
THE '74 OUTBOARDS

New Power and Reliability...and

Johnson's loop-charged 70 is last year's 65-hp model. With no increase in displacement or rpm, Johnson engineers wrung out an extra five horses with improved carburetion and exhaust tuning.

Johnson's Stinger 2 is the same 70-hp engine as above but comes in red and black colors and contemporary lettering to give it a mod look. Engine in background is a rotary for racing.

Chrysler 60, new for '74, has one carburetor for each of its two cylinders. For precision intake tuning it features a built-in air silencer.



Mercury 4 (right) is a 5.5-cubic-inch single-cylinder manual-start. Like all Merc engines, it recirculates unburned fuel back to the combustion chamber.

Merc 65 (left) has a pulse-tuned exhaust that uses alternating pressure waves from adjacent cylinder exhaust ports, as well as tuned-length exhaust tubes.

Merc 20 (right) can be fitted with an optional electric starting kit. The two-cylinder outboard displaces 21.9 inches. It's an effective, popular fishing motor.

Biggest Evinrude delivers 135 hp from a V4 block. It has power trim and tilt mechanism.

Chrysler 135, a production version of its 150-hp racing engine, is a high-compression mill with large carbs.

a 4-Cycle from Japan

Whether you want to troll or get out there fast, there's an engine for you

By JIM ROE / *PS Boating Editor*

Most of the U.S.-built '74 motors will look much like the '73 models, but there are some new features for both stamina and style. Outboard Marine is launching an electric troller under both Johnson and Evinrude brand names, and both makes will be offering a limited number of motors with jazzed-up cowl styling. There is one complete newcomer on the scene: a 7.5-hp four-stroke outboard from Honda.

Here's a sampling of the '74 outboards you'll be seeing at the boat shows and in dealer showrooms.

Evinrude. Eighteen different outboards will bear the Evinrude name for 1974. Evinrude "tops out" with the new 135-hp Silver Starflite, a deluxe V4, styled in hand-rubbed silver paint, bright trim, and sent out from the factory with power trim and tilt feature installed.

Three V4 powerheads are available: 135, 115, and 85 hp. To help make these powerful engines more durable, a new piston alloy has been developed that exhibits greater strength at full-power high-operating temperatures. Midrange motors include 70-, 50-, and 40-hp models. For the economy-minded, there's a 25-hp model that can burn lead-free gasoline.

Near the low end of the horsepower scale, Evinrude is offering two brand-new fishing and sailboat auxiliary motors with 9.9 and 15 horsepower.

New to the Evinrude line this year is the all-electric "Scout," designed to aid the angler in slow and silent running [see story, this issue]. The two-hp Mate continues to be Evinrude's smallest internal combustion outboard.

Mercury. Merc continues to lead the horsepower parade, with its

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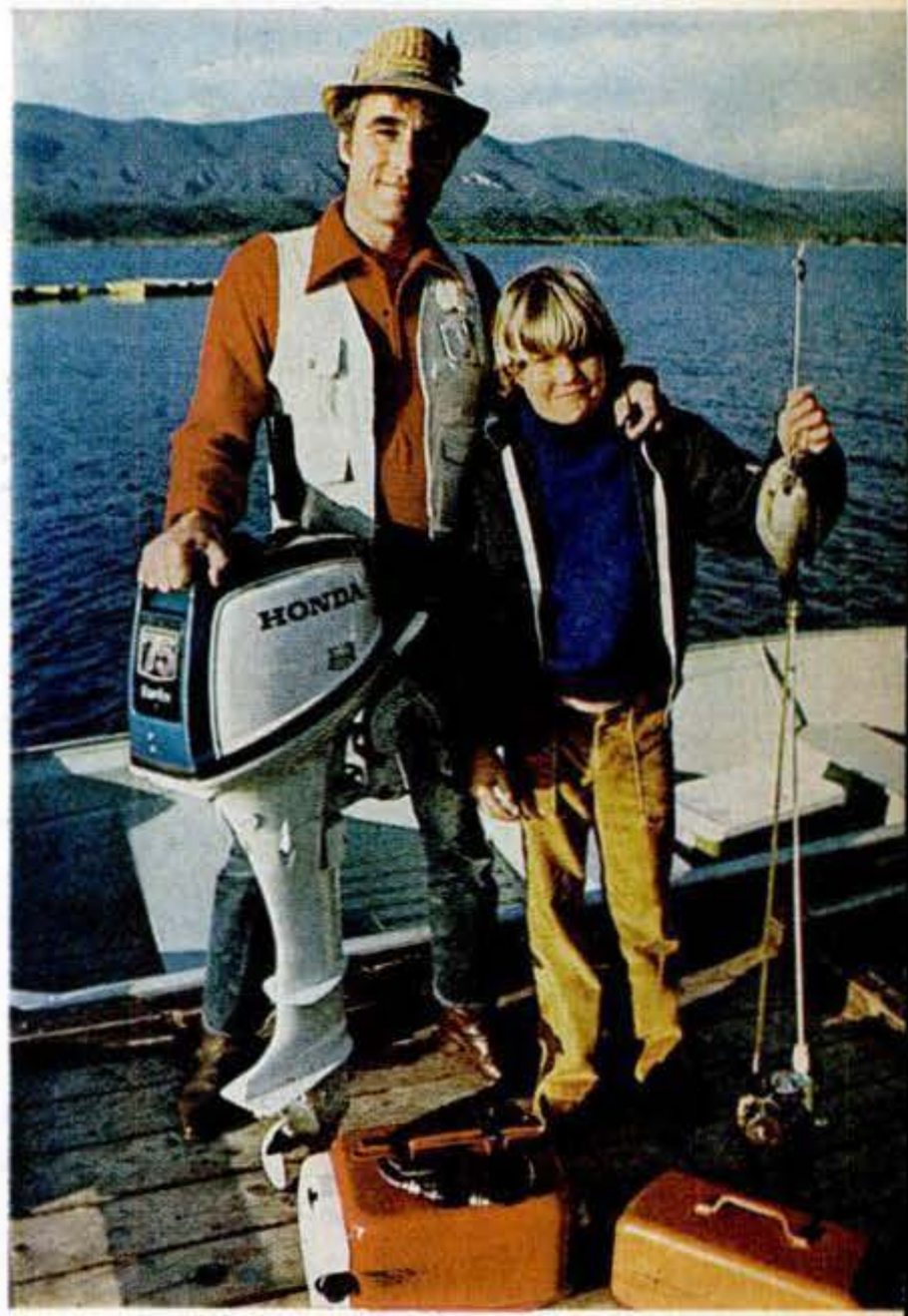

Honda's four-cycle is reported to consume about ¾ gallon an hour at full throttle. Oil is pressure-fed to all of the engine's bearing surfaces.

Merc engines are available from 4 to 150 hp (the largest production outboard). At left is the 9.8 hp, one of the mini-Mercs designed for fishing.

Evinrude's new 9.9 (left) is a low-profile engine. It's three inches narrower and two inches shorter fore and aft than last year's 9.5-hp model.

Chrysler's new 10 (right) is made for fishermen and sailboat enthusiasts. It has shallow-water drive, full gearshift, acoustical silencing.

Otterbine's BSOJ3 jet is ideal for trolling in shallow water. No part of the jet drive unit extends below the boat to snag on weeds or bottom.

six-cylinder 150-hp outboard. Other Mercs extend down to four hp. All are in-line design, with one to six cylinders.

Power trim is now standard equipment on the long-shaft 150- and 115-hp Mercury outboards. The trim has a double-acting hydraulic system that provides remote push-button trimming of the motor for a more level ride under changing water and load conditions.

Several new developments are designed to better serve the fisherman. The "mini-Mercs" of 4 to 20 hp have a built-in fish-line cutter, which effectively chops off even tough monofilament line before it can damage the hub seal.

Every production Mercury outboard features an internal fuel recirculating system. This returns unburnt fuel or crankcase residuals to the firing chambers.

Johnson. There are four new Johnson outboards for 1974. In August, PS brought you an exclusive preview look at two of these, the new 9.9 and 15. Each packs more power into a small package. The 9.9 and 15 each have the same 13.2-cubic-inch powerhead—two inches less than last year's 9.5. The two new motors are also lighter and smaller than the 9.5-hp motor.

The third new Johnson for 1974 is an electric, a cousin of Evinrude's model.

Johnson's fourth newcomer is the loop-charged three-cylinder 70, a more powerful version of last year's 65, but with the same displacement and operating rpm. The extra horses come from a refined exhaust-tuning system, improved carburetion, and a higher compression ratio. Johnson offers 32 outboard models for 1974, in 12 horsepower classes.

Chrysler. Chrysler is unleashing seven new models for 1974: 5-, 10-, and 15-hp fishing motors, a 60-hp midrange outboard, and three high-performance engines with 75-, 90-, and 135-hp output. In all, Chrysler has 19 horsepower categories ranging from its 3.6 Swinger to a limited-production 150-hp racing motor with high compression, race-style porting, and big-bore carburetors.

Most advanced of the new Chryslers is the 60. It incorporates Chrysler's condenser-discharge ignition system, which works on the same principle as Chrysler's new car ignitions (see article, p. 86). Distributor and points are completely eliminated. You get easier starting and smoother idling. The new 60 also has direct-flow fuel charging for optimum performance at any speed.

All Chrysler outboards of 60 hp or more come with a solid-state battery saver. This is a combination voltage regulator/rectifier that limits the maximum voltage output of the alternator. It also permits the current to flow in only one direction, giving extra protection to accessories and extending battery life. All remote models of 35 hp or more, too, have a "cruise" position on the throttle. When you shove the throttle to cruise, the spark automatically moves to full advance. Chrysler engineers claim it can save up to 25 percent on fuel.

Honda. For the first time the Japanese giant is offering an outboard in the U.S. market. It's a four-stroke, which eliminates mixing oil and gasoline.

The new 7.5-hp Honda is an overhead-cam engine, designed for marine use. The water pump is lined with stainless steel for resistance to wear and corrosion, and coated on the outside with Teflon.

Designed for easy serviceability, the engine has a handily removable hood with adjustable hood latch to maintain a correct fit. The whole starter mechanism can be removed by loosening three bolts. You can take off the cylinder head without removing the entire engine. Normal maintenance items such as spark plugs, points, and carburetor are easily accessible. The Honda is available at some marine dealers, and from Honda motorcycle dealers.

Sears. Sears is offering its Ted Williams outboards in horsepower packages of 3, 5, 7.5, 9.9, and 15.

The small three-hp engine has a single-cylinder, air-cooled powerhead, with water-cooled exhaust. The 7.5-hp model, available with or without reverse gear, has a completely sealed, solid-state ignition system with transistorized circuits—no ignition points to burn out or replace. Starting is by hand, with a recoil starter.

Both of the "larger" Ted Williams motors—the 9.9 and the 15—come with full gearshift range: neutral, forward, and reverse. They have the same solid-state ignition system. An automatic rewind starter kicks 'em off for you.

Minn-Kota. This is the company that is said to have introduced the first electric fishing motor—back in 1932. Today it offers a complete line of these quiet motors, in a variety of sizes, styles, prices, and powers. All have 360-degree operation and start-stop foot-control switches. All models also have motor-mounted directional pointers.

The new Magnum 75/12/24-volt motor is designed to handle the biggest bass-boat rigs. It delivers 24 pounds of thrust at 3055 rpm, draws 23 amps of current. The lightweights are the Minn-Kota 10 and 15 models, which draw only nine and seven amps at top speed.

These electric motors have ceramic permanent magnets, which, says Minn-Kota, will be as powerful 10 years from now as today. And the motor housing is designed for rough use: sealed to prevent condensation, strong enough to bang against rocks and keep going.

Minn-Kota offers three "over-water" motors, too, with the motor above the water and power transmitted via shaft to the propeller. The largest of these, the model 40, is designed to maneuver a 16-foot boat.

Shakespeare. Shakespeare offers 12 electric fishing motors for 1974. They weigh from 5.5 to 11 and deliver from 5.5 to 20 pounds' thrust. Most will operate on either 6 or 12 volts, with two models operating on 12 volts only and one model designed for 24-volt operation.

The 24-volt model has been extensively tested in both fresh and salt water, and under sustained use, says the maker. It has forward-reverse and three-speed switches. The circuit breaker is actuated as a clutch if underwater obstructions are encountered. Power comes from two 12-volt batteries in series. PS

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Xerox's 6500 Makes Color Copies on Any Paper

Three colored toners combine to produce seven-color copies on new machine

By JOHN R. FREE

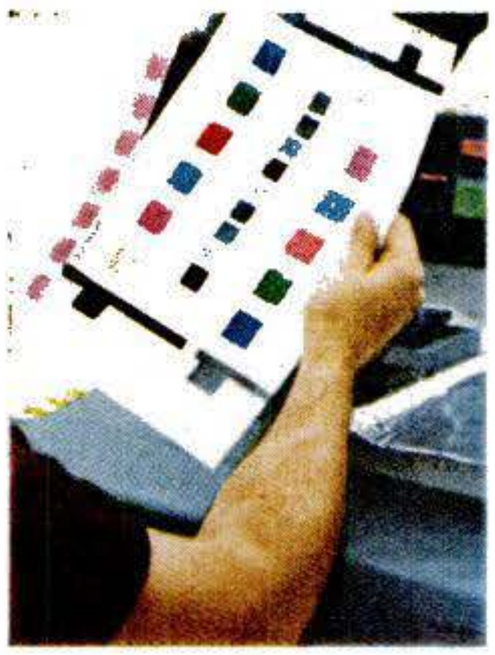
Making a colorful splash on the New York-area market this fall is Xerox Corp.'s latest machine, the 6500 color copier. Like the first Xerox 914 introduced in 1959, the 6500 creates copies on ordinary paper and transparency material. (3M has offered a color-copier machine for several years that requires specially treated paper for each copy.) By mid-1974, says Xerox, the 6500 should be available nationwide.

A subtractive color system is used in the 6500 to create seven colors—red, blue, green, cyan (a shade of blue), magenta, yellow, and black, a combination of all colors—from three toners (see below).

A technological breakthrough in producing panchromatic selenium alloy for the photoreceptor drum made the development of the 6500 possible, says Xerox. The new alloy is responsive to all colors, while the orthochromatic drum of some black-and-white copiers and duplicators is not.

Time to produce the first full-color copy is 33 seconds, with additional copies from the same original produced in 18 seconds.

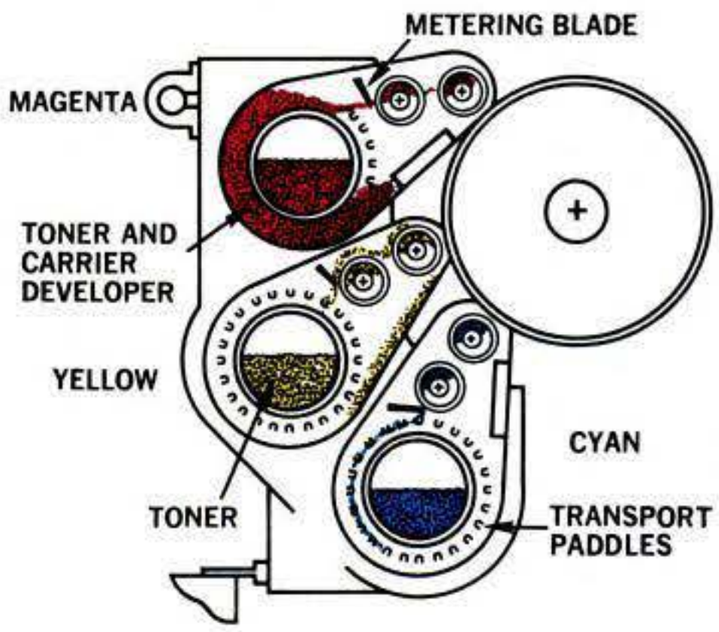
Xerox experience with color dates back to the 1960s, when color toners were produced to help Walt Disney studios prepare color cartoons. PS

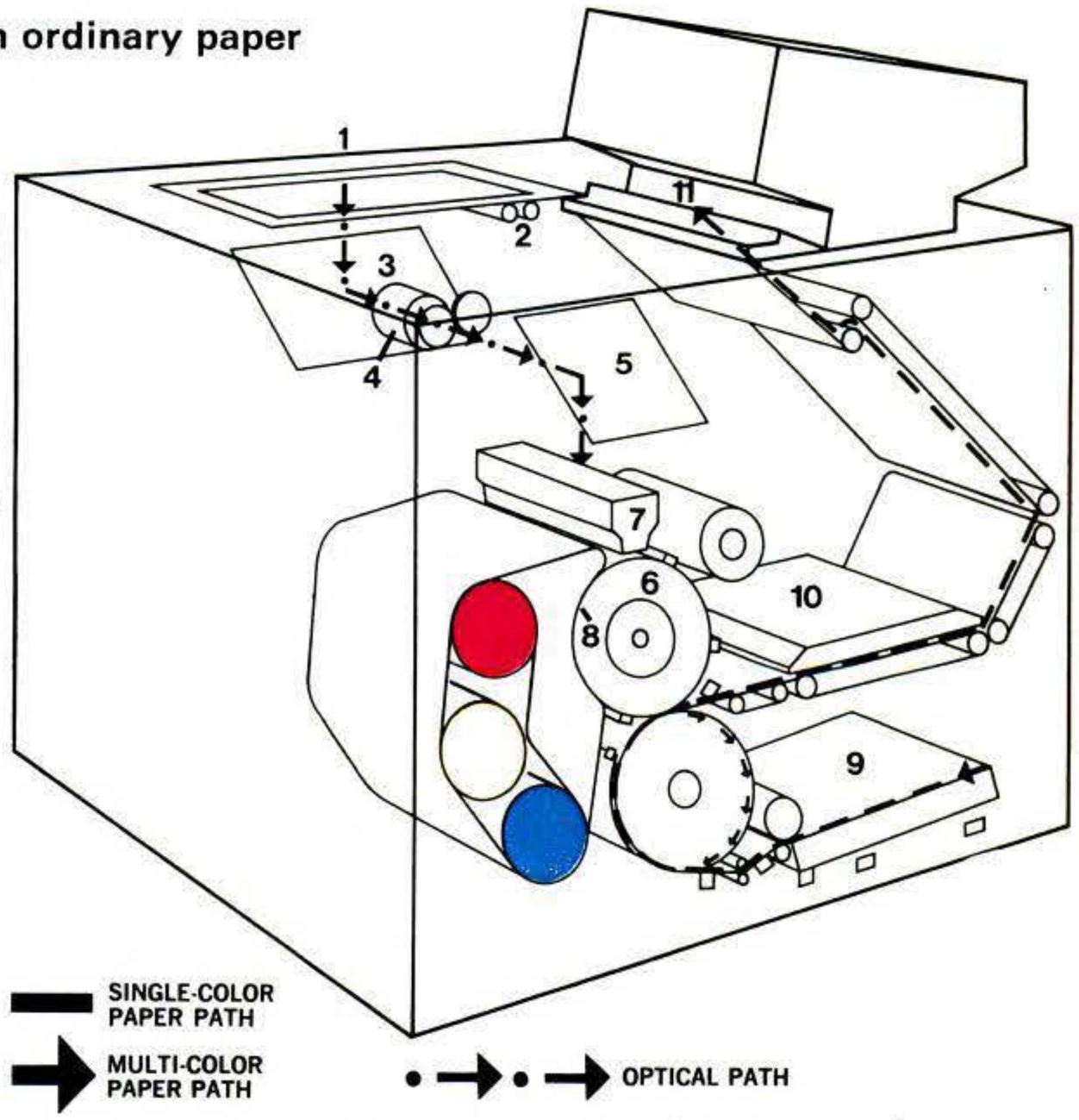


Color copy made from portrait photo used three basic toners—cyan, magenta, yellow—to give an approximation of original. Xerox says technique of carrying toners magnetically rather than cascading them is the key to even coverage of halftone or solid areas. The 6500 will also prepare color transparencies for projection.

Widest applications for new seven-color copier is expected to be in providing charts, maps, tables, layouts, and diagrams.

What goes on inside the 6500 to create color copies on ordinary paper





Document placed face down on the platen glass (**1**) is scanned by moving lamps (**2**), and its image is projected onto the object mirror (**3**). The image is reflected from the object mirror through a lens and color-separation filter system (**4**) onto the image mirror (**5**). This mirror projects the image through the exposure box (**7**) onto a positively charged light-sensitive drum (**6**). The light image, in the first cycle, has passed through a green filter and discharges the drum in non-image areas. Next, magenta toner, the filter's complementary color, is applied to the latent charged image remaining on the drum with rollers containing rod magnets (**8**) —detail, above. Negatively charged toner, which coats magnetic-carrier particles, is taken to the rollers by paddles. The toner is attracted to the charged image on the drum; carrier particles, which remain on the rollers, are recovered. Paper from the tray (**9**) is held on a charged transfer roll, which attracts the toner image from the alloy drum and holds it on the paper. The paper is held on the transfer roll for up to three sequential images, depending on the number of colors selected. The second cycle exposes the document through a blue filter, applying yellow toner in exact registration over the magenta toner. The final cycle uses a red filter and applies cyan toner over the magenta and yellow. The paper is then transported to the fuser (**10**) where heat fuses the color toners to the paper. The melted toners give a glossy appearance to the copy. The copy paper then goes to the receiving tray (**11**). The 6500 runs in full-color, three-color, or single-color mode.

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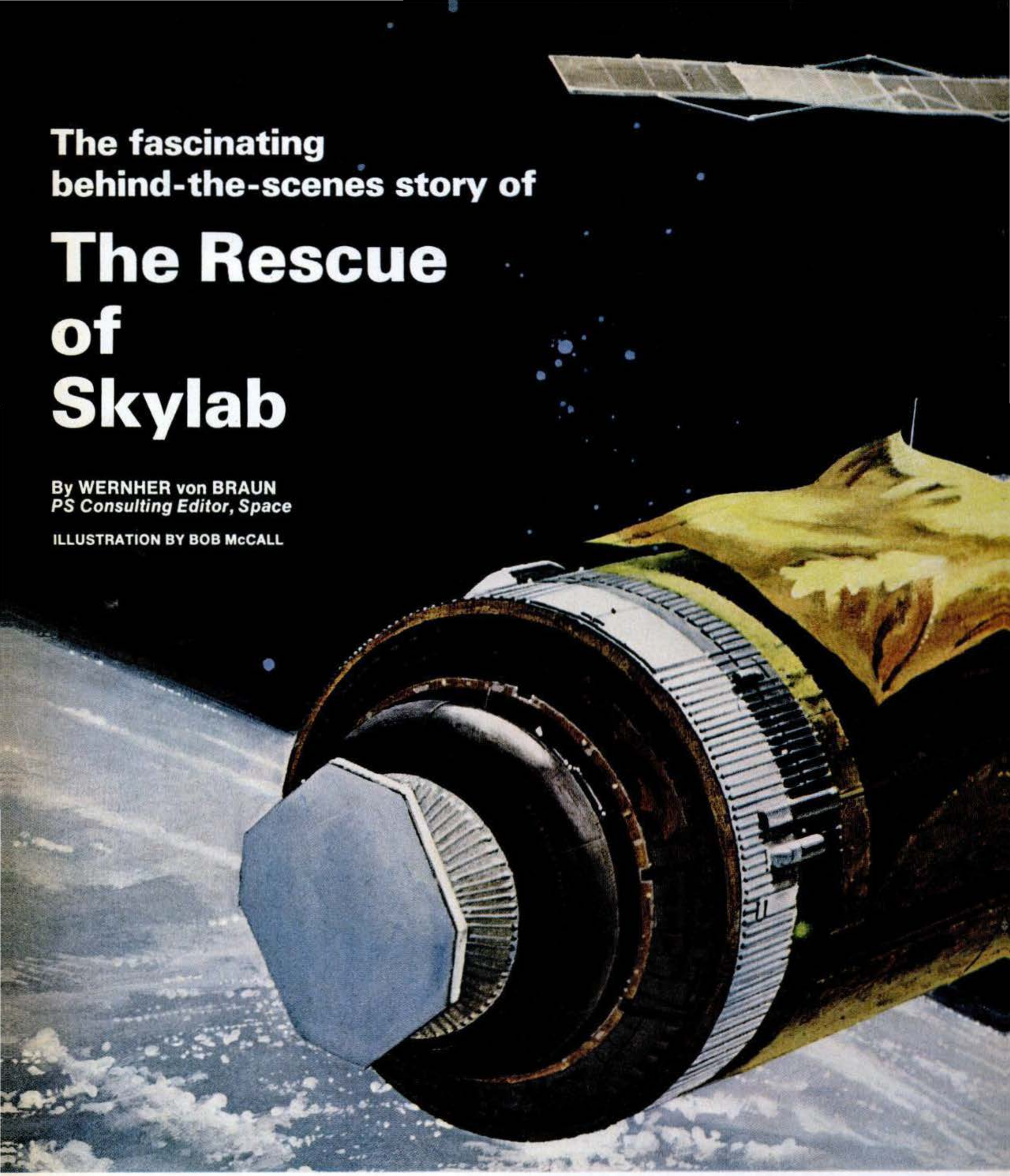
The fascinating behind-the-scenes story of

The Rescue of Skylab

By WERNHER von BRAUN
PS Consulting Editor, Space

ILLUSTRATION BY BOB McCALL



Our second Skylab crew should now be back, and our third one preparing to go up this month or next.

Neither flight could have taken place, but for the spectacular space-repair feats of Skylab's initial crew—which put the first manned mission in a class by itself. Dr. von Braun's revealing account of it will give you, as it gave us, a new insight into what was happening as astronauts and groundlings raced the clock to save crippled Skylab.—The Editors

Around the world in 270-mile-high orbit, once every 93 minutes, sailed our first space station. It was the largest spacecraft ever built, 118½ feet long with its three-man crew's earth-to-orbit Apollo ferry attached. Twenty-four days after its launch, it could also claim to be our most patched-up, lopsided spacecraft—and claim it proudly, considering the emergencies that this inelegance had enabled it to survive.

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Dramatic spacewalk by Conrad and Kerwin (latter beside long-handled cutting tool) frees solar wing—seen at lower right unfolding its panels, innermost one last—and relieves desperate shortage of electric power. Object extending below and beyond tool is a Skylab antenna. Colored parasol atop Skylab in foreground, already deployed from inside, shades it from solar rays and ends overheating that made it uninhabitable, after loss of micrometeoroid shield bared aluminum hull to the sun.

Incredibly, a huge, gaily colored parasol sprouted from its hull. One of its two main solar-power wings was spread to the sun, the other one missing. But the important thing was, Skylab worked.

By erecting the improvised parasol, and by extending a jammed solar wing in a spectacular spacewalk of more than three hours, Skylab's first crew saved the entire $2½-billion project from disaster. Their prowess as space repairmen put the stricken space station, seemingly hopelessly damaged in launching, back in order for their own 28-day mission and for the far-longer missions of two crews to follow.

They had helpers on the ground. Some invented and produced brand-new space hardware with unheard-of speed. Others perfected unprecedented spacewalk maneuvers, in a huge underwater tank. This is the story of how the combined endeavors rescued Skylab.

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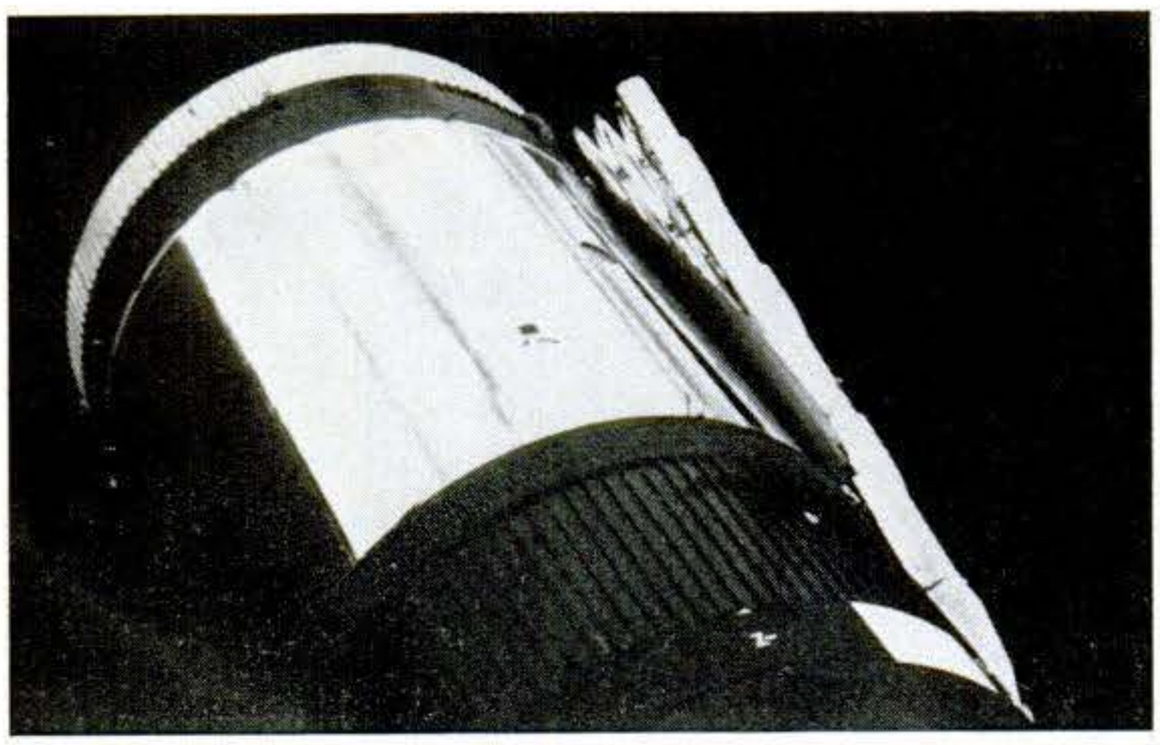
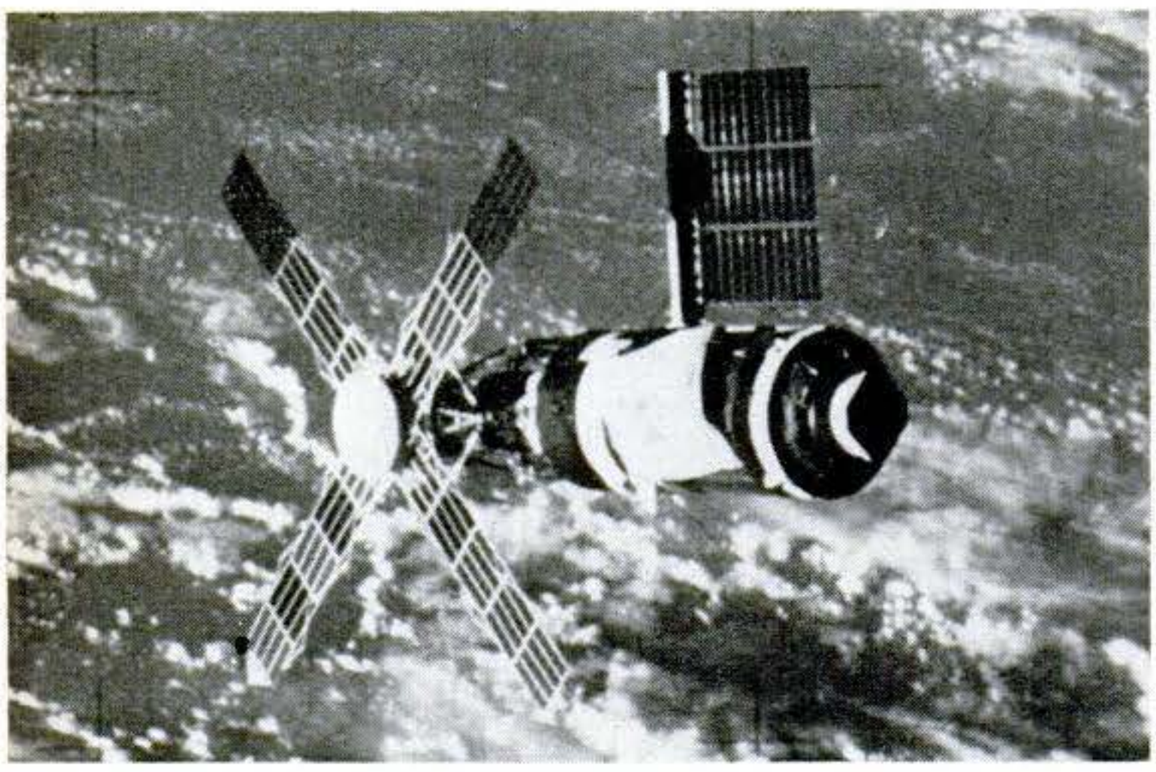
Repairing a stricken space station in 270-mile-high orbit opens the way



Before repairs, jammed solar wing is seen barely opened, at right of Skylab's cylindrical Orbital Workshop, in photo made during Apollo "flyaround." Compare later view, below.



After repairs, freed wing is fully extended (above Skylab). Departing crew's photo also shows parasol (white patch), and windmill-like solar arrays of Skylab's telescope mount.

Cutting tool that released solar wing is displayed, left, by backup crewman Rusty Schweickart. He and a teammate rehearsed spacewalk to do job on Skylab mockup submerged in huge tank, below, at Marshall space center, to simulate zero g. Floats made the tool "weightless."

Launched in one piece. Skylab was orbited unmanned, but completely assembled, last May 14. Joined end to end were three sections: a Multiple Docking Adapter where a crew would park its Apollo craft during its stay; an Airlock Module with a hatch for spacewalking; and an Orbital Workshop, the largest section, a two-story central laboratory and living quarters converted from a Saturn V third stage. A solar-observatory tower, the Apollo Telescope Mount, would pivot out sideward from the Multiple Docking Adapter after Skylab reached orbit.

A key ingredient of our story: Skylab was our first solar-powered manned spacecraft. Two wing-like solar arrays, on opposite sides of its Orbital Workshop, were to be hidden during ascent within two hollow beams—held down alongside Skylab like the arms of a soldier standing at attention. In orbit they were to swing out, on radio command, as if the soldier raised his arms to shoulder height. Then panels of solar cells, folded accordion-wise in each beam, would unfold alongside the Workshop. The two 28-by-30-foot solar wings, the largest ones ever flown in space, would furnish more than half of Skylab's electric power. The rest would come from a windmill-like solar-array cluster on the Apollo Telescope Mount.

The huge Skylab was launched by a two-stage Saturn V rocket. A smaller Saturn IB was to boost its first crew up to it the next day. Fate ruled otherwise.

Trouble struck fast. Only 63 seconds after liftoff, Skylab was in big trouble. It was coming apart.

At about 40,000-foot altitude, the supersonic slipstream tore away the Orbital Workshop's micrometeoroid shield—a thin flexible shell of aluminum, intended to lie tight against the hull during launch, and then to be extended five inches by torsion bars.

Wreaking havoc, the wind-whipped debris jammed one solar wing. It broke tie-downs of the other wing—which, opening prematurely, was ripped completely off.

First inkling of this came when Mission Control in Houston commanded orbiting Skylab to open its wings—and nothing happened. From the Orbital Workshop's solar-wing system came a puny 25 watts, instead of expected thousands. An analysis of Skylab telemetry from liftoff to orbit told what might have occurred.

In a pinch the Apollo Telescope Mount's "windmill" could spare power to the Workshop. Even a crew's Apollo could contribute a little from its fuel cells. But Skylab's supply for spacecraft operation and for science experiments was grievously curtailed.

Heat wave in Skylab. Worse was to come. The lost shield would have shaded the Workshop from the sun's fierce glare in space. Without it, the interior's temperature shot up past 120 degrees—and Skylab's living quarters became uninhabitable. That did it.

Out the window went NASA's script for the first crew's mission. Instead, for the first time, a crew would go up to try to repair a disabled spacecraft.

Skipper of the all-Navy crew was Capt. Charles ("Pete") Conrad Jr., 42, veteran of Gemini 5 and 11 and Commander of Apollo 12. His shipmates were Comdr. Joseph P. Kerwin, 40, full-fledged M.D. and the first medical spaceman; and Comdr. Paul J. Weitz, 41. In that order the three bore a Skylab crew's titles of Commander, Science Pilot, and Pilot.

Their launch was postponed five days, then five more, to equip them for their revised mission. But time was running out. Food, medicines, and films for three successive crews would soon spoil aboard the ovenlike craft. The heat even threatened to poison Skylab's two-gas oxygen–nitrogen atmosphere, with toxic

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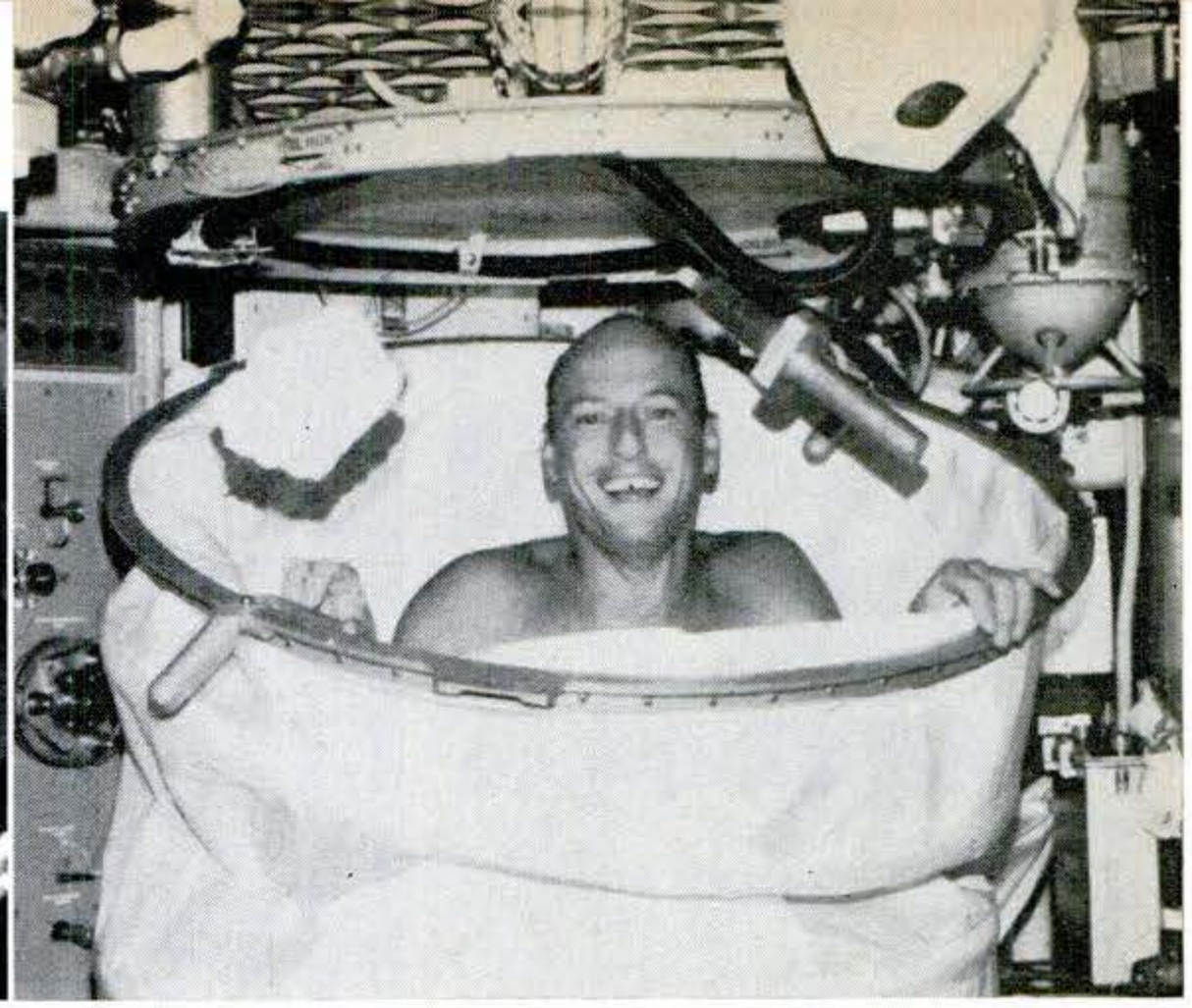
Running around Skylab wall is new space sport. Centrifugal force enabled crew to stride erect after start shown (by TV) from toeholds between lockers in ring around wall.



First showers in space refreshed Conrad, above, and his crewmates. Skylab shower has pushbutton spray and vacuum system to collect and dispose of the droplets of water.

fumes baked from polyurethane-foam wall insulation.

Rigging a makeshift sunshade to cool the overheated Workshop was the crew's most urgent task. They carried alternate versions—the most favored, a parasol designed and built in six days at Houston, which arrived barely in time for their May 25 launch.

First look at crippled Skylab. When the crew rendezvoused with Skylab, 7½ hours after liftoff, a "fly-around" inspection confirmed NASA's diagnosis of the damage. Where one solar wing had been, only bits of jagged metal and dangling wires remained. The other wing, snagged around its beam by an aluminum strip from the torn-off shield, had barely opened—accounting for the 25 watts reported by telemetry.

From their Apollo, the crew made a daring attempt to free the stuck wing. Conrad piloted the craft so close to Skylab that Weitz could lean out of the opened hatch and yank at the strip with a 10-foot tool shaped like a shepherd's crook. Nothing budged. They couldn't open the wing with the tools they had, they reported. (Better luck would come about two weeks later.) They docked to Skylab, and slept in Apollo.

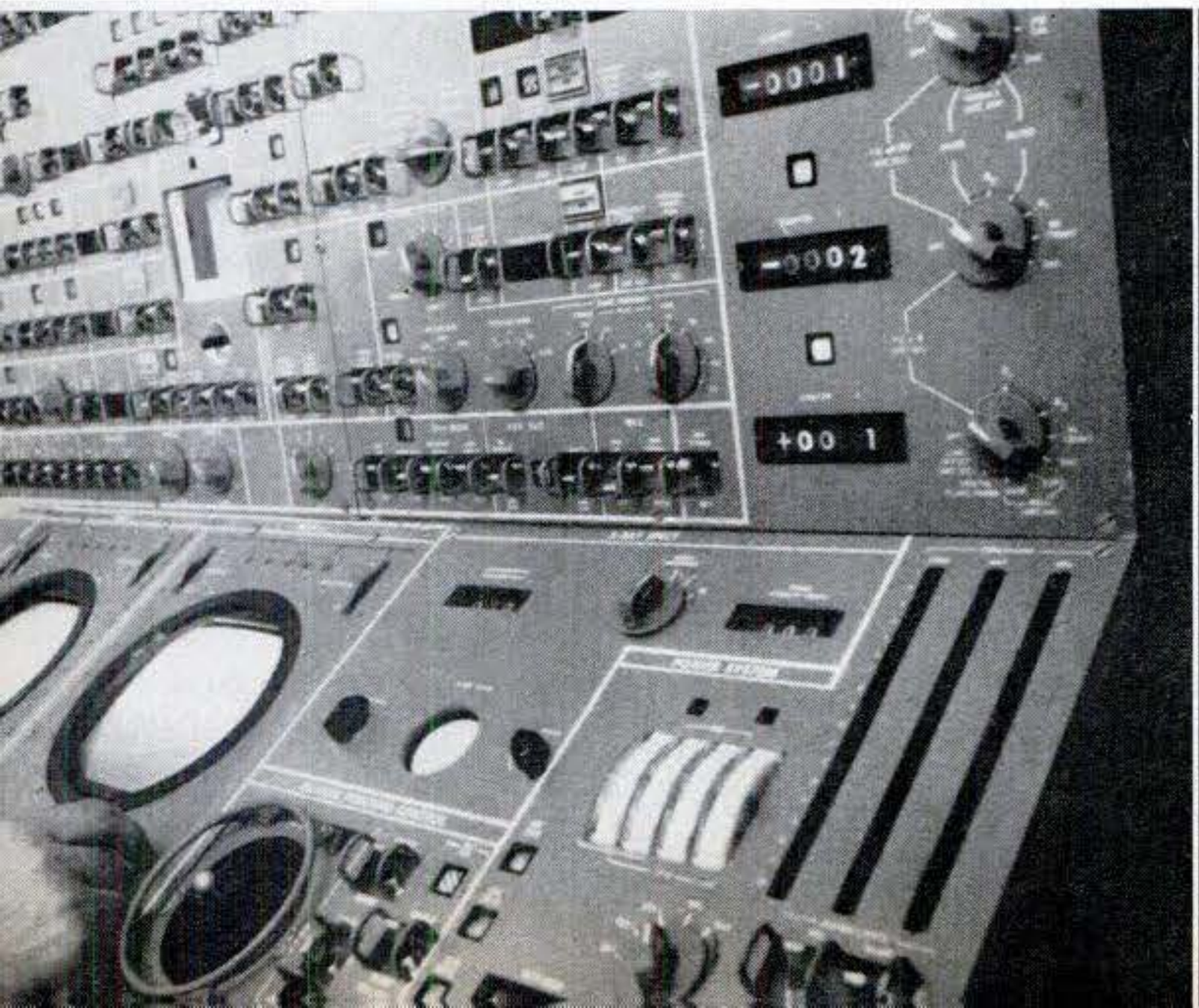
First to brave Skylab's heat next day was Weitz—wearing a gas mask in case toxic fumes lingered in the craft's atmosphere after repeated venting. There weren't any, a chemical test showed. Weitz started fans to make the Workshop's temperature bearable, and he and the others lugged in Houston's parasol. It was first choice for a sunshade because it could be deployed from inside Skylab, avoiding the hazards and difficulties of spacewalking.

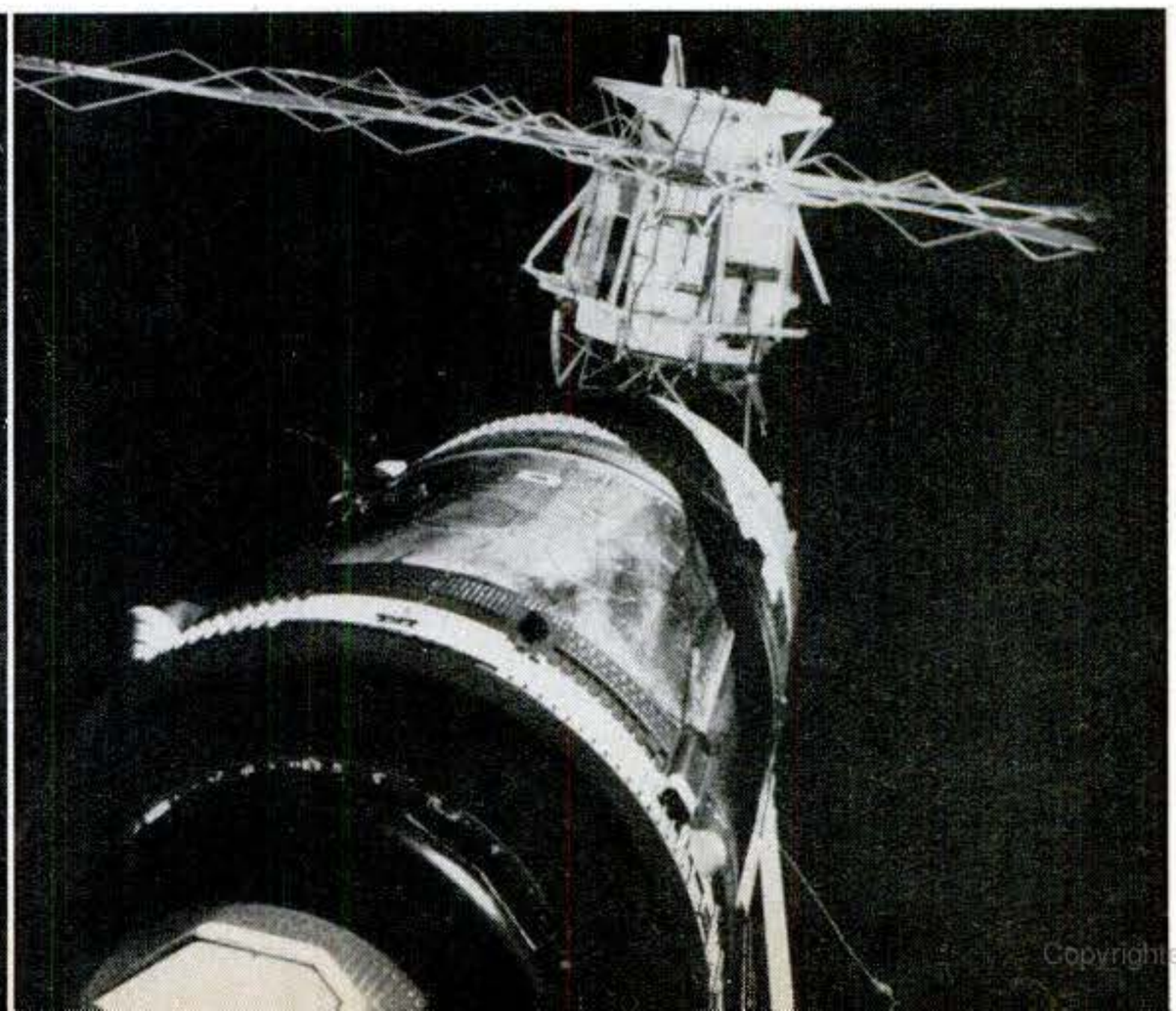
Up goes a parasol. The crew pushed out the folded parasol through an 8¼-inch-square opening in the Workshop wall called a "scientific airlock," designed to expose experiments to the vacuum of space. Adding sections to a "handle" raised the parasol until it cleared the hull. Then it unfolded into a rectangular 22-by-24-foot canopy shading the Workshop—and was drawn back close to the hull and secured there.

The parasol's fabric was nylon cloth of high-visibility golden hue, laminated to metallized Mylar film. It remained a bit puckered up, but it did the trick. Gradually the temperature in the Workshop fell. The crew could sleep in it by May 29; within another week, their quarters' temperature leveled off in the reasonable mid-seventies. (Spots where they went to cool off meanwhile were Skylab's docking and airlock

[*Continued on page 170*]

Down-to-business work of first Skylab mission included making 30,000 photos of sun with station's $121-million solar-telescope array, operated from console (left) in docking section. Miniature joystick at bottom is manual pointing control. Telescope array itself, pictured in orbit (right), extends at right angles to rest of Skylab space station.





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John Deere 300 symbolizes push by maker into the ranks of top sellers. Model is powered by a 292cc Kohler engine, has an improved carb to cut vapor lock. This scooter has a trailing-arm bogie-wheel suspension.

Ski-Doo's new free-air 340, a real speedster, combines a hot engine with slide-rail suspension to give high performance. A new square-shaft clutch takes the hesitation out of acceleration when you squeeze the throttle.

Double Eagle, a new '74 from Raider, is unique: You ride *in* it instead of on it. The rear-engine vehicle has two eight-inch tracks, for a very stable ride. But with your legs all the way under hood, they can't be used to absorb shocks.

Evinrude gets a new image this year with its Skimmer series. These new 15-inch tracked machines come with either a 400cc/35-hp, 440cc/40-hp, or 650cc/50-hp engine. All have CD breakerless ignitions, fully instrumented dash panels.

Suzuki XR-440 is the Japanese maker's top-of-the-line model. It has a hefty 37-hp, 432cc twin. The XR-440 combines advanced engineering with handsome styling and full instrumentation—as well as extras like dual rear-view mirrors.

Nimblest Mercury ever is the 440 S/R, which has a new slide-rail suspension rather than bogies—a first for this maker. The track has cleats permanently molded in, and tread pattern helps control sideways movement on hard-pack snow.

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For '74—Hottest Pack of Snowmobiles Ever

Improved power, handling, and reliability mark this year's ski-scooter crop

By HERBERT SHULDINER

The horsepower race is on again among snowmobile makers. The reason: Sluggish sales for the past few seasons.

Sluggish? Only a snowmobile manufacturer would think so. Last season, some 500,000 new snowmobiles buzzed out of the salesrooms, to make a total of 2½ million now in use. With fuel, accessories, and the machines themselves, snowmobiles have become a billion-dollar industry.

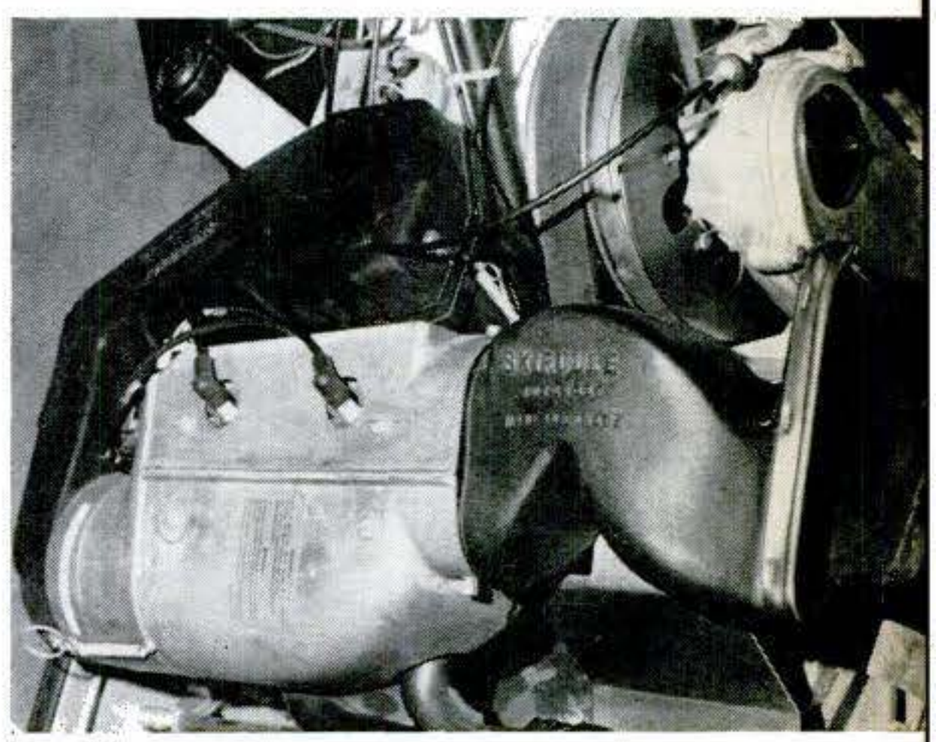
Noise control? Not this year. As legislative pressure has diminished, efforts to control noise have come to a virtual standstill. This is the year of performance.

Last year, only one company offered a stock 50-hp engine. This year, at least a half-dozen offer engines in this power range.

Companies such as Mercury and Outboard Marine Corp. (maker of Evinrude and Johnson, never before noted for hot machines) have produced 50-hp engines for 1974. Rupp, Chaparral, and Skiroule also have 50 hp packed in at least one model.

Continued

Sleek Skiroule Laser, a hot entry, has a 50-hp, 440cc, five-port Kohler engine. CD ignition and surface-gap plugs help ease starting and prolong plug life. Ski and rear shocks are standard on this 15-inch-tracked machine.



Huge intake ducts developed by Skiroule help increase power output of engine, while curbing intake noise. Unlike intake silencers, which cut horsepower, these ducts actually increase power.

Scorpion Super Stinger 440, lower than ever, has a track only 14⅝ inches wide, supported by a patented Para-Rail suspension. This combination of bogies and slide-rails is an attempt to gain advantages of both systems. The 440 is powered by a JLO 434cc engine.

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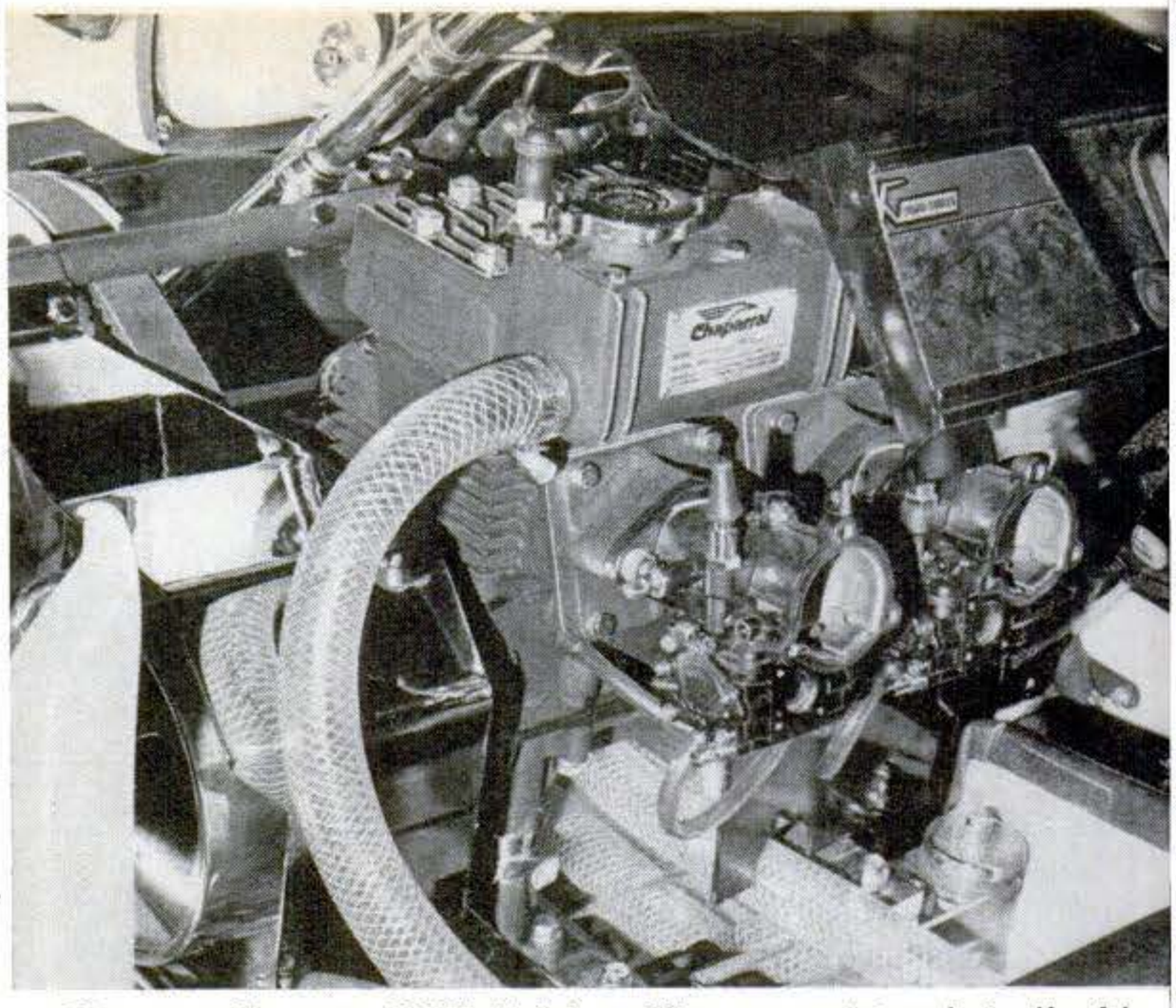
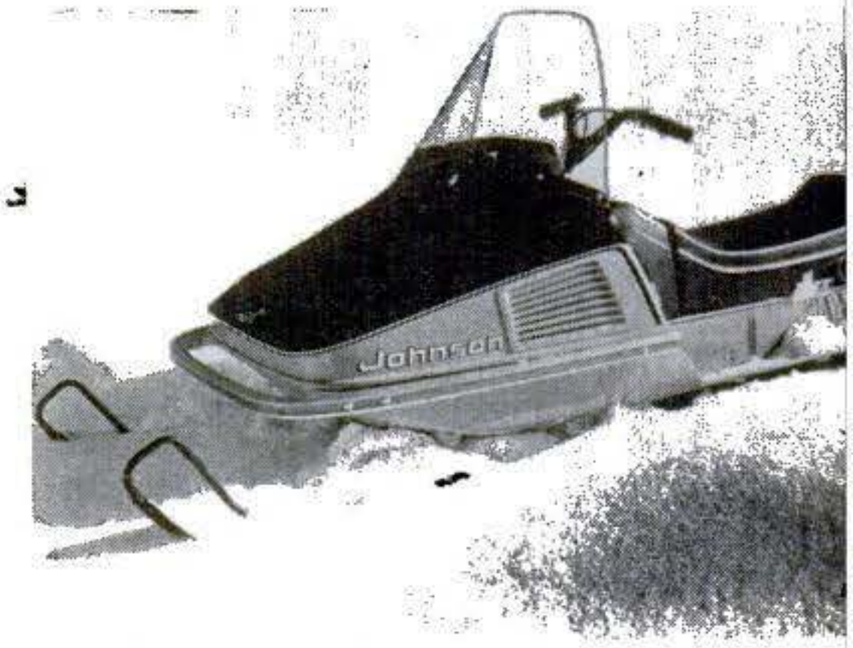


Chaparral's new SSX (left) typifies newest trend: to liquid-cooled engines. Chaparral will devote more than half its production this year to snowmobiles powered by liquid-cooled engines. The new engine (above) will come in two sizes—a 338cc model rated at 40 hp and a 432cc rated at 50 hp. Chaparral says the liquid-cooled power plant will be smaller than equivalent air-cooled versions, with more consistent horsepower output and less danger of overheating. The engine has reed-valve induction and dual carbs. The top-of-the-line vehicle will be equipped with CD ignition, luxury-type upholstery and dash. It has a 15½-inch track and slide-rail suspension.

Moto-Ski's Chimo is a stable-riding wide-track designed for family snowmobiling. It's powered by a 440cc two-cylinder engine and is one of the longest snowmobiles made. This makes it ideal for carrying two persons.

Sporty Sabre Jet has hottest engine offered by Sno-Jet this year: 440cc and 39 hp. The front-mounted engine plus wide-stance skis increase vehicle's riding stability. Styling is patterned after Sno-Jet's Thunderjet racer.



Johnson JX 650 is one of the most surprising new entries this year. Its alternate-firing twin cranks out 50 hp, yet weighs no more than most 440cc engines, according to OMC. Model has lightweight frame to go with the engine.

Revamped Harley-Davidson comes with two engine options: 398cc and 433cc H-D twins. It also has breakerless CD ignition for easier starting. The new wide-track model is well built and loaded with ride-smoothing features.

Rupp Nitro II boasts a 55-hp engine—one of the largest available for general sale. It features CD ignition with surface-gap plugs and automatic adjustment of air/fuel mix for temperature and barometric conditions.

Elegant Polaris Electra is one of the few '74s with major emphasis on safety and quiet operation. The new 18-inch-wide track has a completely sealed, acoustically insulated hood to cut noise, along with a new improved muffler.

Other companies may have such engines in their line, but have not said so publicly. The reason: Fear of the implications of a horsepower race. In some instances, in fact, the announced horsepower ratings are lower than the engines' actual capacity.

The heftier horsepower ratings have been obtained with new and bigger engines, or by tuning existing engines to turn out more power. There also has been a big shift to slide-rail suspensions, instead of bogies. Slide-rail suspensions help the track get more power to the snow. John Deere, Mercury, and Yamaha are among the companies that have introduced their first slide-rail suspensions this year.

Liquid-cooled engines. One of the most interesting developments this season is the proliferation of liquid-cooled engines. A small Minnesota company, Brutanza Engineering, launched the trend last year. But, being a small company, they had little impact on the total market. This year, Chaparral has brought out an SSX series of snowmobiles with liquid-cooled engines. And Alouette is offering a new model that takes to the trails with a Kohler liquid-cooled engine.

The big advantages of liquid-cooled engines are better noise suppression and more consistent horsepower output. The engine runs at a constant temperature, governed by a thermostat, and is less affected by ambient temperatures or by throttle settings.

At the same time, there has been an increase in the number of free-air-cooled engines. With most snowmobile engines, fans blow air over the surface to provide cooling. Free-air engines duct air in to provide the cooling.

Fans, of course, steal engine power. Eliminating the fan picks up a bit of power. However, free-air engines run considerably hotter than fan-cooled ones; it could reduce their longevity. For competition-minded snowmobilers this may not be a basic consideration, but the average owner might find it costly over the life of his snowmobile.

Reliability is up. On the reliability side, CD ignitions continue to catch on. Combined with surface-gap plugs, which are growing in use, CD ignitions should reduce the snowmobiler's biggest mechanical problem—fouled plugs.

CD ignitions also have eased starting, a nuisance with some models. The increasing use of two-cylinder engines also has helped here; twins are easier to turn over than single-cylinder mills.

There's been considerable improvement in ride comfort on many '74s. Part of this results from the big trend toward more and better shock absorbers—both on the skis and on the rear of the snowmobile. Seats are thicker, too, and cushioned with foam of varying density to absorb ride shock and provide you with more comfort.

Many safety hazards have been removed. Foot traps and shin bangers are much rarer now. There are better hold-ons for rear passengers.

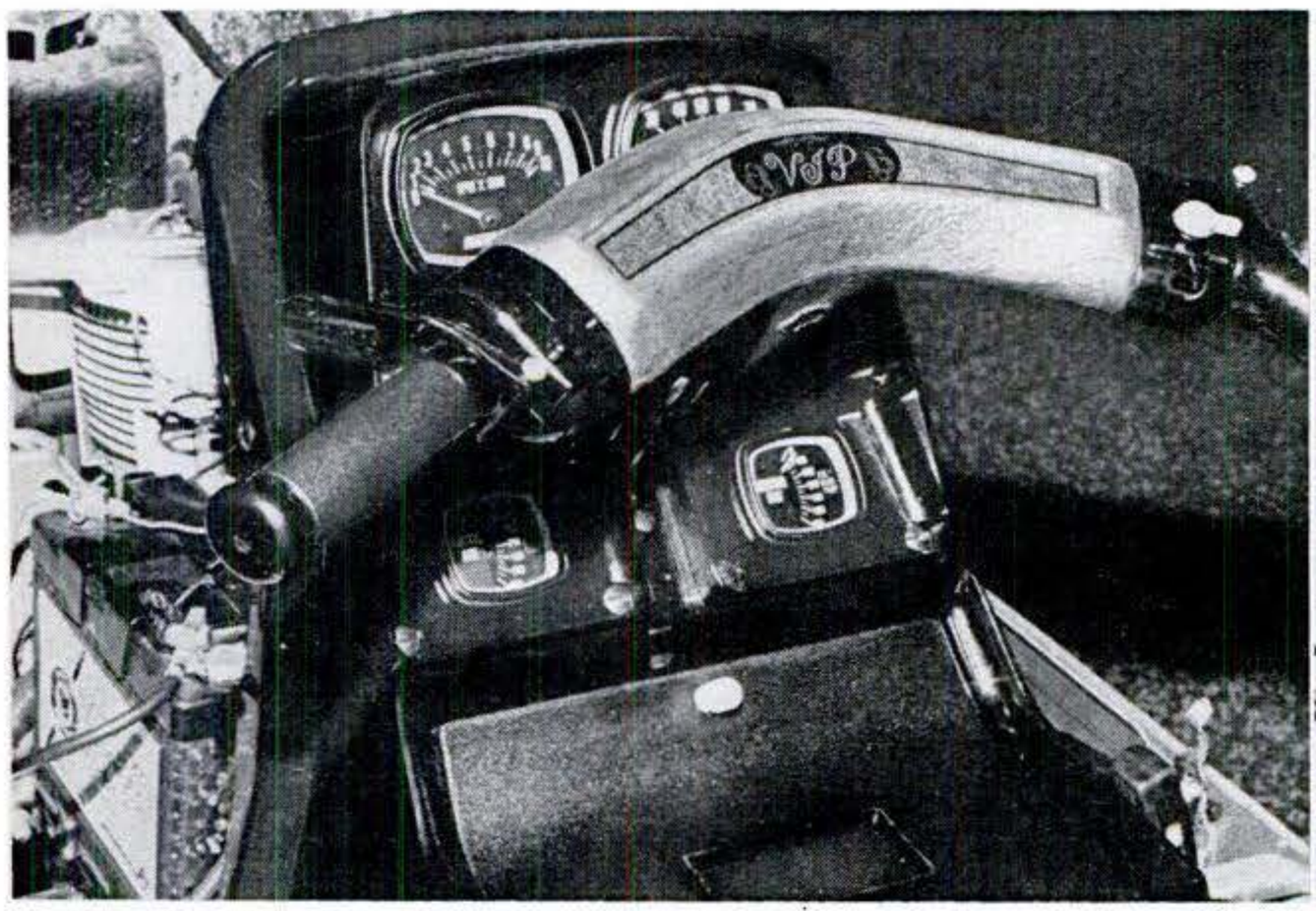
Many more snowmobiles now have padded handlebars and dashes to cushion you against injury upon impact. Moving parts are more effectively shielded to prevent accidents. Clutch guards, especially, have undergone great improvement in covering the spinning mechanism—yet don't hinder you in changing belts, even out in the field.

Yamaha GP 292F is one of the few remaining snowmobiles with a single-cylinder engine. It cranks out 27 hp and, like rest of Yamaha line, doesn't need oil and fuel pre-mixing. Injection system meters exact amount of oil needed.

Other advances show up in the chain and track tensioning systems. There's less need for lubrication, because many moving parts are now sealed for life.

Despite the many changes in the '74 models, there's little that's revolutionary. Some 340,000 snowmobiles were left unsold at the end of last season, and manufacturers will try to move them first. There's little desire, this year, to make last year's models look obsolete.

But some 400,000 of the '74s are slated to move into dealer's showrooms this winter. With that kind of supply, chances are you'll be able to wangle a good deal if you're planning to scoot through winter this year. PS



Arctic Cat VIP Panther is one of the most luxurious snowmobiles offered this year. Console (left) has outstanding instrumentation, and it's loaded with improvements: beltless hydraulic torque converter for smoother starts, electronic ignition, surface-gap plugs, and an oil-injection system. VIP has a 440cc Kawasaki twin with a standard electric starter. Its 17-inch-wide track and torsion-spring slide-rail suspension give one of the best rides around.

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Author Kocivar tries out the captain's seat after his fast ride. Jungle of dials at right is flight officer's domain.

Aboard the *Concorde SST*

Flight-test engineers answer Kocivar's questions. They monitor SST's eight tons of test equipment, checking on some 3000 parameters of performance.

Digital readout tells passengers in rear they are flying more than twice the speed of sound. Yet they can move around the cabin as freely as in subsonic plane.

With the first commercial supersonic transport service to the U. S. scheduled to begin by mid-1975, Popular Science's Flying Editor describes what it's like up front in the cockpit

By **BEN KOCIVAR** / *PS Consulting Editor, Flying*

Mentally, I had to pinch myself to be sure it was true, but sure enough, there I was kneeling behind the captain's seat in the needle nose of Concorde 02.

"What's our speed?" I asked Gilbert Defer, who was flying First Officer in the right-hand seat. He pointed to the Mach meter directly in front of the narrow-handled control yoke—it looked like a set of antelope horns—and with two fingers confirmed what my eyes saw: Mach 2, with the needle inching up toward Mach 2.02.

"A bit over 1300 mph," he said as my eyes widened. The altimeter showed 51,000 ft., and we were still moving up to flatten out eventually at 54,000 ft.

There was no physical sensation of speed. In the tiny cockpit for the two pilots and a flight engineer who sat sideways behind them, facing his instrument panels on the right, the noise level was low enough to permit conversation with only a slight voice rise. It was like being in the nose of a 707, but cozier. Captain Jean Franchi's and First Officer Defer's shoulders seemed little more than a foot and a half apart. Between them on the console I could see the four throttles that unleashed enough thrust to make the 204-ft. delta-wing giant practically stand on its tail during takeoff.

Continued

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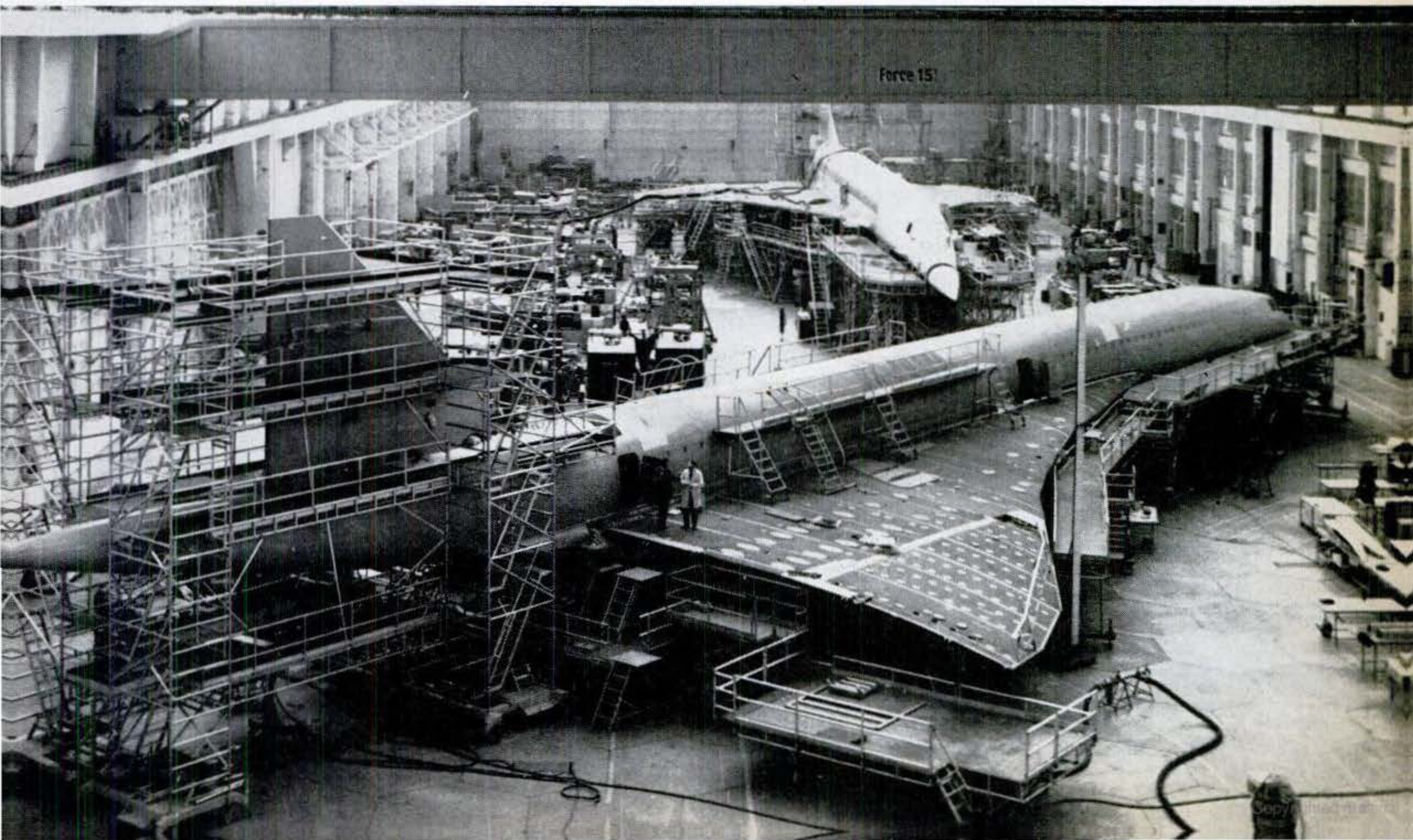
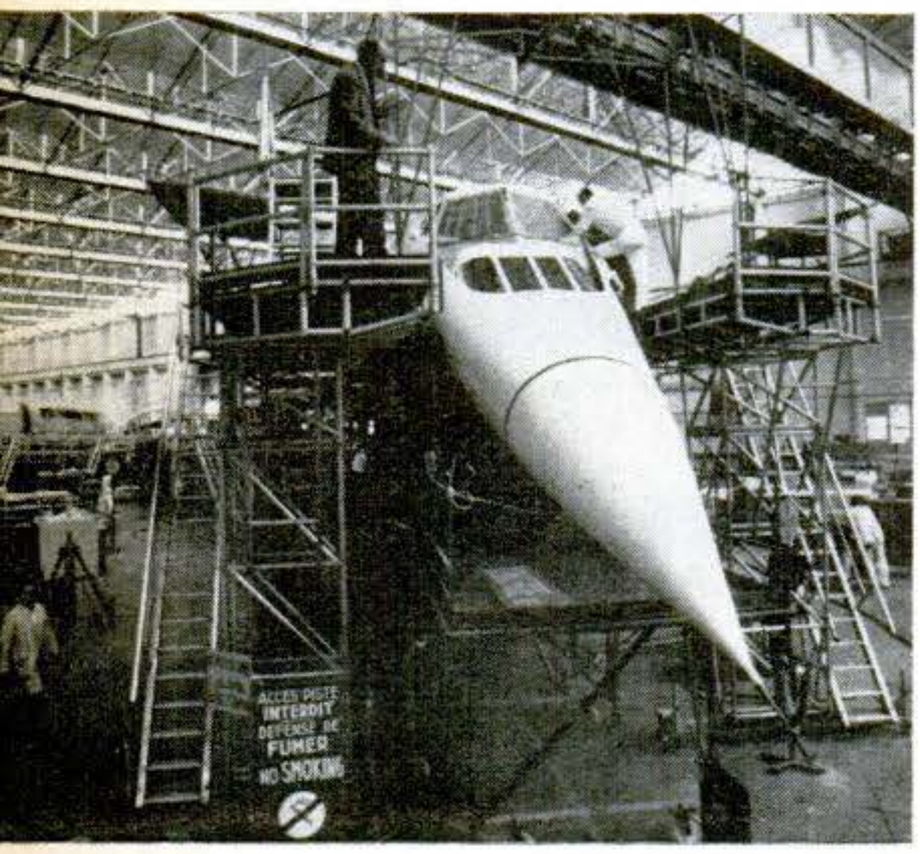
Prototype 001, shown over Paris, flew astronomers across Africa at 56,000 ft. recently during major solar eclipse.

You'd Never Know It's Mach 2

Production version has a much longer tail cone—and improved engines that leave little visible smoke in the air.



Wing plate identifying the production plane is pointed out by Kocivar. Nine Concordes are on order, but some long-lead items are already ordered for No. 22.



No. 1 production plane, in Toulouse, is studied by Kocivar. Odd-numbered planes are being assembled in France, even-numbered ones in England.

It was hard to admit there was no physical sensation of speed

We had taken off from Le Bourget near Paris little more than half an hour before on a 1500-mile trip westward over the Atlantic to below the southern tip of Ireland.

"We've done the round trip to Iceland twice and went over 3700 miles nonstop," Gilbert Defer told me. "In fact we were all prepared to fly from Paris to Washington before the air show this year, and fly back with a dozen American congressmen just to prove how fast and easy it is. But somebody in the top British and French government vetoed the idea at the last minute because they were afraid of your environmentalists." As we go to press, however, a Concorde is slated to land here in September for the dedication of the Dallas-Fort Worth super airport.

I can report that inside the preproduction Concorde, which is one of four test versions now flying, the environment was dandy. For takeoff I sat way back in the tail in one of the 32 tan-leather first-class seats over the delta wing. These were the size seats to be used in the 108-passenger configuration, four across with an aisle down the middle.

Afterburner push. As we rolled down the runway for takeoff there was a noticeable push as the captain flicked on the four toggle switches behind the throttles that turned on the powerful afterburners. A chorus of "wows" came from the passengers, and then another murmur about 27 seconds after we started to move as the nose came up at a steep angle, and we simply tilted back and went on and on and up into the sky.

"How many degrees up was that?" I later asked Defer.

"Pullup is about 22 degrees and takeoff speed between 186 and 212 knots," he told me. The angle is then lowered to about 17 degrees for climb, and lowered again to about 12 until cruise altitude is reached.

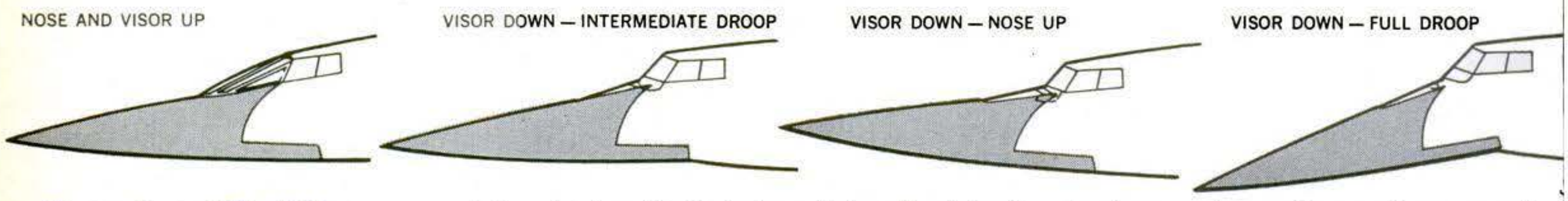
The afterburners come into play again just before Mach 1 to give an extra boost to cruise at Mach 2. Jean Franchi, who is the chief test pilot on the Concorde and project pilot for 02, told me later: "The afterburners are used to about 47,000 ft. and Mach 1.7. From then on cruising thrust of the four turbines is used, and acceleration is slow by comparison. Yet, within 10 minutes we reach 50,000 ft. and just over Mach 2."

We stayed subsonic over land to avoid making a boom, but within a half-hour of takeoff the cabin indicator showed us going past the speed of sound.

Passengers relax. Up front in the middle and forward sections of the ship, 02 was still fitted with big panels of test equipment and three engineer stations mounted sideways along the length of the narrow fuselage. There had been an air of nervous excitement at the start. Yet so casual was the atmosphere now, and so much like flying in a conventional airliner, that the relaxed passengers seemed as much intrigued with the passing out of Concorde neckties as with the historic SST experience.

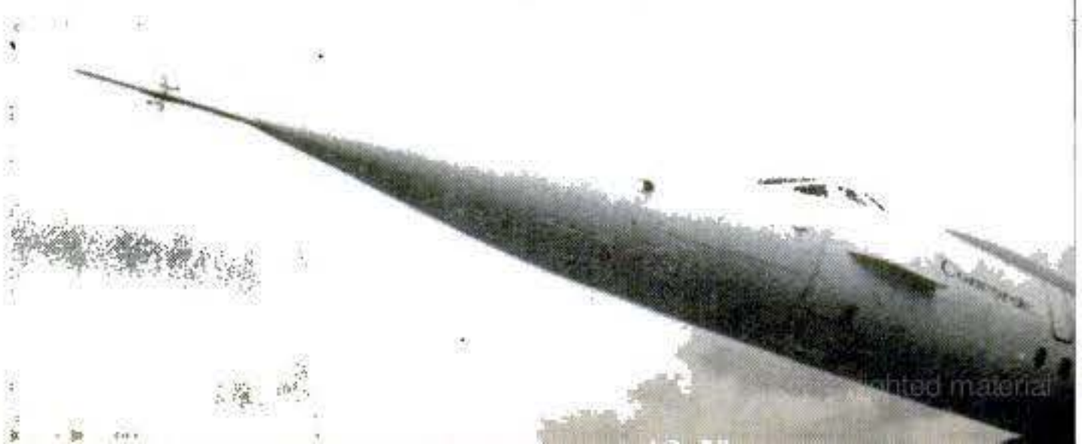
Sitting in the extreme rear, I no-

[*Continued on page 142*]



Concorde and Tu-144 noses are both hinged to improve pilot's forward visibility. At high speeds, nose and visor are kept up for best streamlining. For takeoff, visor is down and nose is tilted down five degrees. For subsonic cruise, visor is down and nose is up. For approach, landing, and taxiing, visor is down and nose is full down at 17 degrees.

New Russian Tu-144 (left) has variable-camber canard wing used for better control in slow flight. Wing retracts back into fuselage for better streamlining at high speed. Concorde (below) has small fixed canard, just below cockpit, that also improves control at slow speeds but does not retract at supersonic speeds.

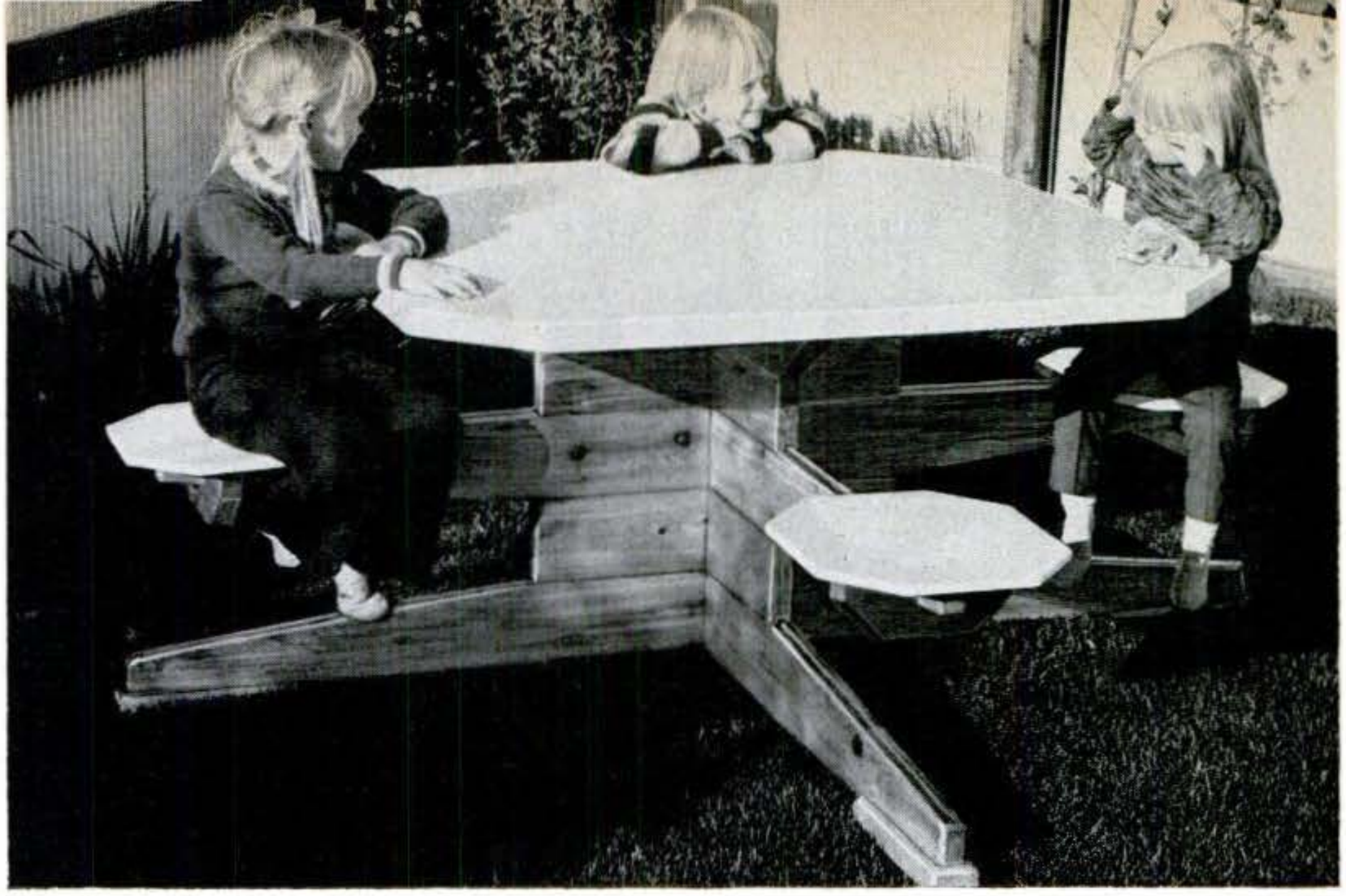


ONE-WEEKEND PROJECT • COMPETITION •

$200 AWARD EACH MONTH

FIRST MONTHLY WINNER:

Don Cooper of Calgary, Alta., Canada



Radially-designed table has built-in seating for four, room for four more on folding chairs. It's sized to provide eating comfort for both adults and kids.

Half-Notched T&G Picnic Table Knocks Down for Storage

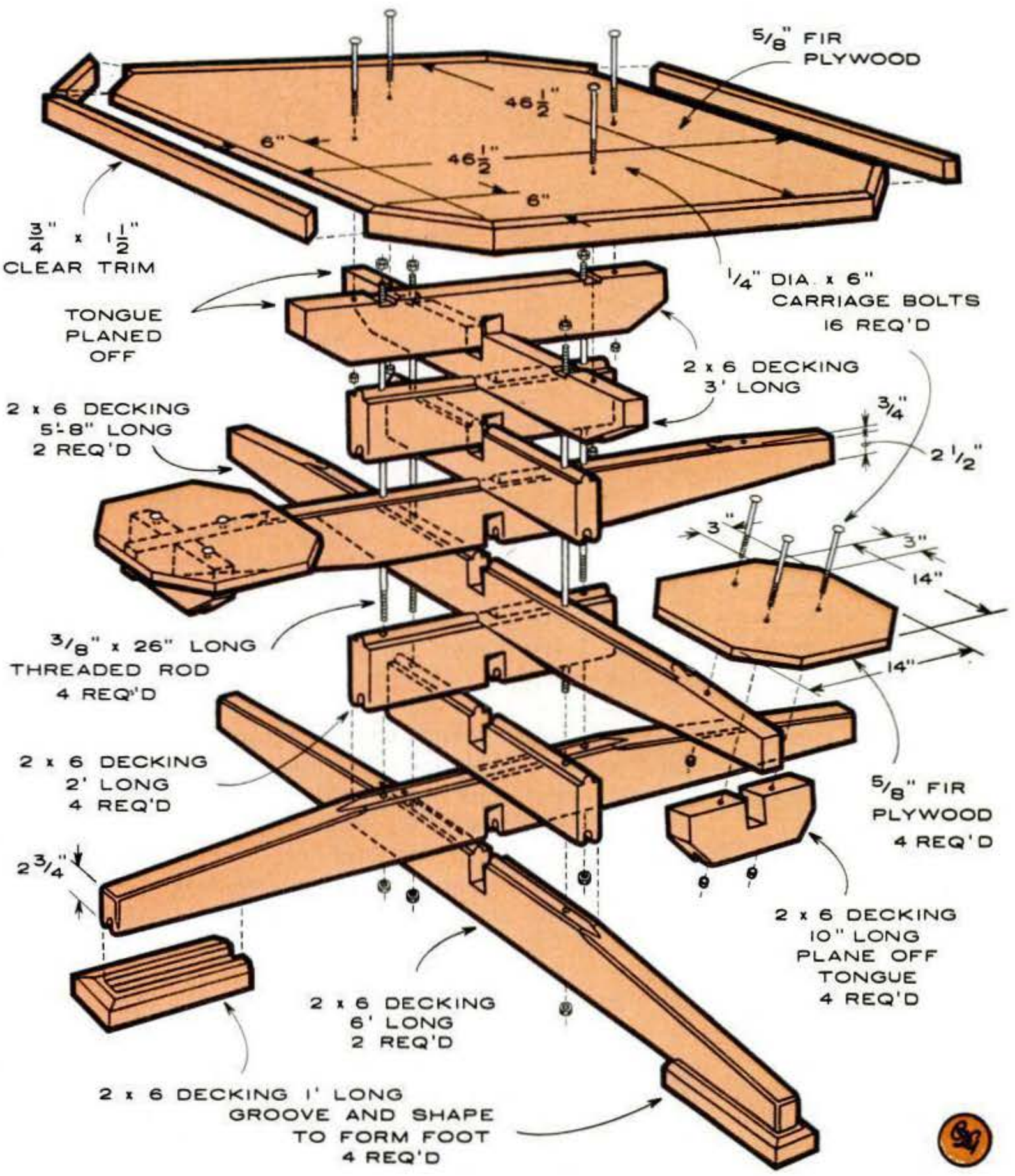
Here's the winner of our first monthly project award—a unique picnic table made from tongue-and-groove cedar decking. Why did we choose it out of the hundreds of entries received? Several reasons:

- It's a good-looking design, lightweight, yet strong.
- It's a clever use of a common building material.
- It provides comfortable seating for four, without the need to step over the seats to sit down. And there's plenty of room for another four picnickers on folding chairs.
- It knocks down for convenient off-season storage.

Want to make one of your own? Here's how: Start by cutting the 10 crosspieces to length and profile. Then make the center-half notches. This is easiest with a saber saw. Next, drill each piece to take the ⅜" threaded rods. Use a ½" bit to simplify alignment problems.

Seat supports and feet come next. As shown in the sketch, the feet are grooved to fit their crosspieces, then glued in place. If you like, eliminate the groove and screw the feet on from underneath.

Last come the seats and tabletop, all cut from plywood and bolted in place. Use plated bolts. Finishing? The cedar doesn't need any. Plywood parts should be primed with a product like Firzite (to minimize surface checking). Then apply at least two coats of enamel. PS



Want to enter your own design in our Weekend Competition? See page 153.

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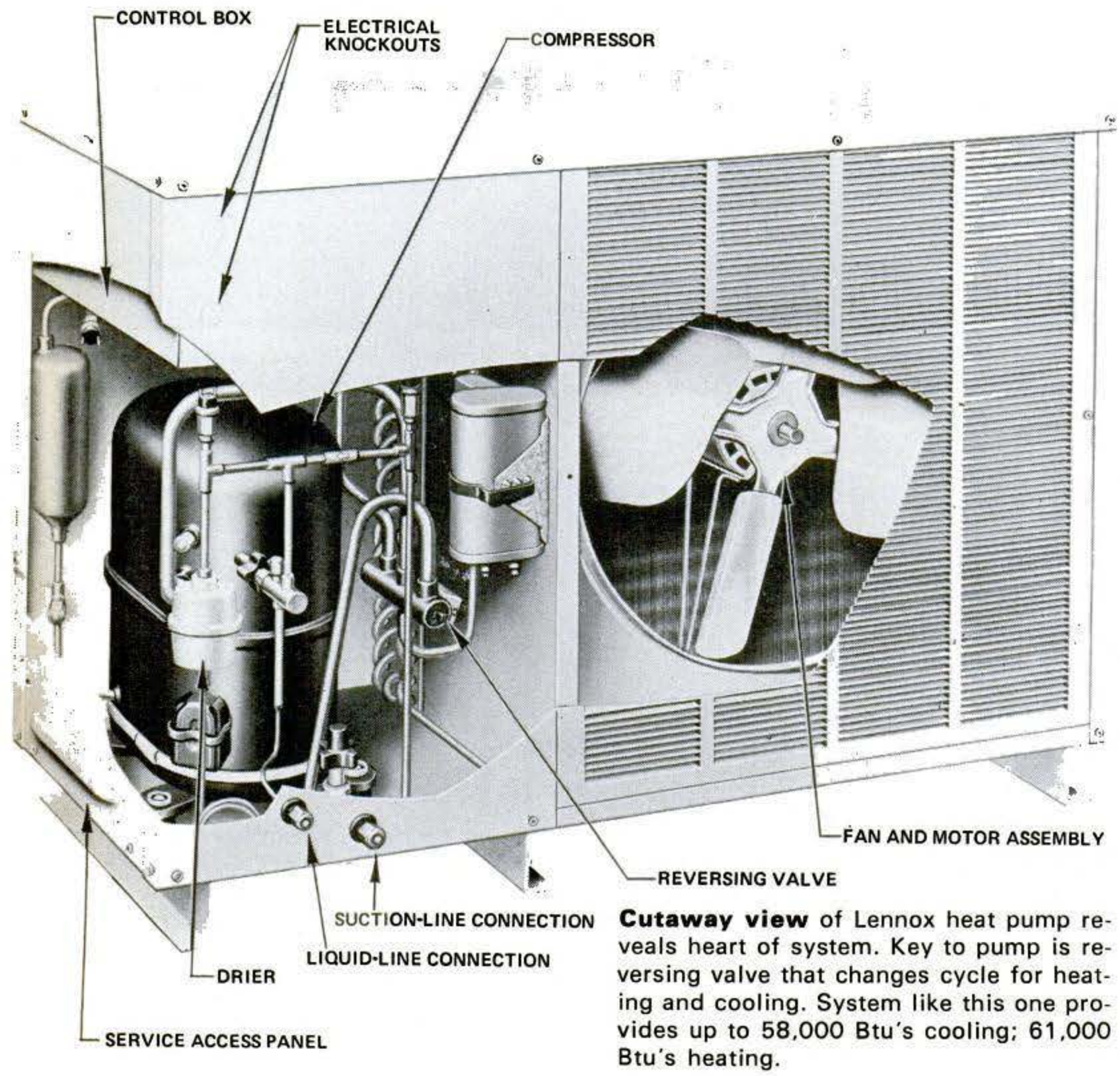
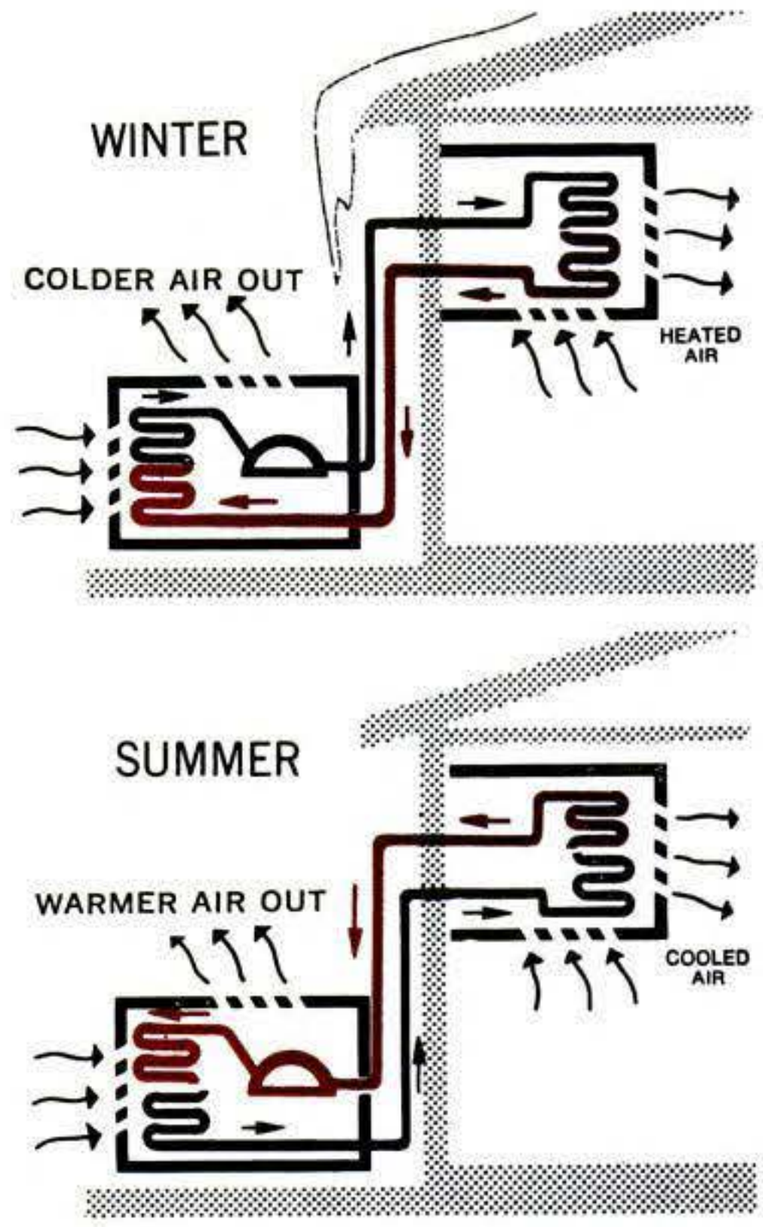
These intriguing electric heating/cooling systems bombed when they first appeared. But the mechanical problems seem to be solved, and the makers are pushing them again

Will Heat Pumps Make a



Cutaway view of Lennox heat pump reveals heart of system. Key to pump is reversing valve that changes cycle for heating and cooling. System like this one provides up to 58,000 Btu's cooling; 61,000 Btu's heating.



Heat pumps are simply central air conditioners with a reverse cycle for heating. In summer, the refrigerant absorbs heat from the room and exhausts it outdoors. In winter, cycle is reversed, with refrigerant—colder than the outside air—picking up heat from the outdoors and releasing it inside the house.

By ROBERT GANNON

I need a new heating system. The old furnace not only guzzles oil like a sunburned brontosaurus, but is about to expire from sheer exhaustion. So I have to replace it. Now, after consulting with heating engineers, manufacturers, and trade organizations, I've decided to take an unpopular step for a cold climate (upstate New York): install a heat pump.

And I'll tell you why.

First, a little background. The heat pump made its first big commercial splash in the early 50s when GE, Westinghouse, and some other large air-conditioner manufacturers started mass-producing a device to heat in winter, cool in summer.

Essentially, they took conventional air conditioners and gave them the ability to more or less run backward. They called the result "reverse-cycle" air conditioners, or heat pumps.

Here was a heating/cooling device that was simple, efficient, clean—and didn't even need a chimney. In short, aside from a high initial expense, it seemed ideal, especially wherever electricity cost was low.

It looked so good that by the late 50s more than a hundred manufacturers were turning them out.

Then trouble. The units started breaking down. All manner of things went wrong, but even the most minor malfunction often pyramided into compressor failure. And because compressors are sealed units, that meant replacement—for $200 or more.

The big trouble was that in the early days quite a few manufacturers merely placed reversing valves on air conditioners and sold them as heat pumps, without making any design changes. And the pumps just couldn't stand the wide range of temperatures—often a hundred degrees or more—of year-round use.

Some heat-pump makers went out of business. Others limited sales to only the deep South. (One study found that compressors go through seven times the stress in northern climates.) Most put their sales forces on other products and sent their designers back to the drawing boards.

Early problems solved

Some of the problems were easily fixed—noise, failing electrical components, excessive vibration that shook loose connections. Others were tougher. Three typical ones:

- *Defrosting.* Frost gathering on the outside coils acts as an unwanted insulator. It's melted by reversing the cycle and sending heat outdoors for a few minutes. Works well, but such reversal creates a shock to the system; components suddenly change

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Comeback?

General Electric's split heat pump installation shows outdoor unit on concrete slab. Like a typical central air-conditioning system, box contains fan, motor, compressor, coil.

Indoor section of Westinghouse heat pump has electric heater, blower (and motor), air-return duct, indoor coil. Electric heater gives additional heat at cold temperatures.

their function, and temperature/pressure stresses shorten their life.

Early models simply used clocks to reverse the cycle every few hours, needed or not. Today's models use solid-state sensors to measure temperature in the outdoor coil and the surrounding air, initiating a defrost cycle only when necessary.

- *Oil migration.* In all systems, a small amount of oil circulates through the tubes with the refrigerant. In the portion containing liquid, the oil is dissolved; where only gas is present, it slithers along the tube walls. In early models, enough of this oil seeped out so that not enough was left to lubricate. New models have (1) closer-fitting parts to stop refrigerant from taking oil with it, and (2) huge reservoirs large enough to hold two or three times the amount normally needed.
- *Resistance heat.* As the outside temperature drops, the heat pump's ability to draw heat from the air decreases until it can't keep up with the needs of the house. Before that point is reached, though, resistance-heat banks—usually installed in the ducts—are switched on. First-generation pumps were supposed to handle nearly anything, and so when temperatures plummeted below zero, the units strained and strained and finally died. Today most manufacturers admit that additional heat is needed (for the sake of the pump if not the house) at a relatively high temperature, and so most models now switch on the resistance heat when temperatures are near freezing.

Heat-pump boom?

Earlier design problems have now been largely eliminated, and many utilities and most manufacturers claim to see the beginning of a boom.

Some don't. International Heater Co., for instance, after first limiting its sales to below the Mason-Dixon Line, is now getting out of the heat-pump business entirely. "The whole industry has been progressing more or less experimentally ever since the damn thing came out," says Bob Shelton, sales director. "We don't think the heat-pump problems have been solved. We have had excellent results with some of them, and we've had some very bad times with others." Adds Bill Dalton, International's design engineer: "Our compressor failure rate was kind of on the atrocious side."

Still, the heat pump seems to be moving north. Westinghouse, perhaps the most enthusiastic supporter of heat pumps in colder climates, says that northern utilities are talking with salespeople about heat pumps all over the country, and are setting up promotion programs.

Willard Boesewetter, of the Elec-

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trical Energy Assn., a utility trade organization, agrees: "The area of greatest potential growth for the heat pump is, say, from Charlotte, N.C., to Chicago."

Today, only a minuscule percentage of the one-million installed heat pumps are in northern states. But with the sudden enthusiasm for "Save-a-Watt" campaigns, interest is beginning to blossom. Nearly 30 percent of new homes are being outfitted with electric heat now, and utilities finally are looking for ways to hold back on usage—and the heat pump is one good way.

How economical are heat pumps?

One thing is certain: The initial cost is high—usually a few hundred dollars more than conventional heating/cooling systems, or, estimates Hyme Hagle, president of Hagle Supply, Newburg, N.Y., about $800–$900 per ton, total installation, for a house requiring three tons or so of cooling capacity.

Westinghouse figures are lower: A 2½-ton heat pump, for instance, might run $1445 installed, while a comparable electric-cooled, gas-heated plant would be $1230, and an electric-cooled and resistance-heated house, $1250.

Operating cost gets complicated.

Start back at the electric plant. The oil, gas, or coal burned there heats boilers and turns generators and sends electricity to your house. There you change it to heat by running it through conventional resistance baseboard heaters. You get the equivalent of only about a third of the fuel used; the rest has been burned up already, simply making electricity, or lost in transmission.

"Use that same primary fuel for heating in your basement," says Jack Langmead, technical director of the Gas Appliance Manufacturing Assn., "and your efficiency is going to be a lot better."

How much? A home furnace's efficiency is about 75 percent when new (most of that other 25 percent goes up the chimney), and perhaps 65 percent when it's slightly out of tune and a few years old in the average home. By the time the heat gets through the ducts to your rooms (and taking off a few points while things warm), the efficiency has dropped to maybe 55 or 65 percent.

Now put in a heat pump. During the summer the pump is slightly less efficient than the equivalent air conditioner because of the added components involved.

In winter, though, a heat pump will have a coefficient of performance of from 1.7 to 3.1, depending on brand and condition, at 45 degrees F. That means that it pumps out about 2½ Btu's of heat for each equivalent unit of electricity purchased. (That's 8.5 Btu's per watt, compared with 3.4 Btu's per watt from electrical resistance heat.)

So you're getting about 75-percent efficiency now, or, the electric people say, some 15 percent more than the conventional furnace gives. You're way ahead. But that's at 45 degrees. As the temperature drops, so does efficiency, until somewhere close to zero degrees it disappears; you might as well be using resistance heat.

As a matter of fact, you are; your auxiliary resistance banks were thrown in up near freezing, so you've been using electricity like crazy. How much, depends on the unit, the installation, the amount of heat your house needs, the climate, and half a dozen other factors.

Everyone disagrees

And that's why confusion reigns. The only real evidence is comparative figures, and they're hard to come by. Why? The gas, oil, and utility people disagree. The fuel people have figures that show electric heat uses more fuel, while the utility spokesmen can prove with equally impressive numbers that any kind of electric heat uses less of the country's reserves—especially if you add in such things as the gasoline needed to transport oil to your home.

The heat pump seems to make environmental sense, too: Electrical engineer Herold Hayward, says, "The heat pump is the only *negative* polluting heat system around. It not only doesn't add pollution to the air, but because it probably is equipped with a precipitator it *removes* it."

Back at the utility plant, of course, pollutants continue to cloud the sky. "But isn't it better to have one huge energy source to control than 10,000 small ones?" asks utility spokesman Boesewetter.

Last June, in hearings before New York's Public Service Commission, some interesting points were brought out regarding fuel use by utilities. John C. Moyers of Oak Ridge National Laboratories testified that his studies show that the average resistance-heated home in, for example, Philadelphia, is responsible for the consumption of 2.6 times as much fuel as a like one heated by gas.

On the other hand, Moyers says, the typical heat-pump-operated home "consumes essentially the same amount of fuel as the gas-heated home. If . . . the systems are compared for homes having optimum insulation . . . the heat-pump-heated home then consumes five-percent less fuel than the gas-heated."

Actually, on a long-term basis, it may not make much difference anyway. Eventually—maybe in 50 to 100 years—we'll run out of everything—oil, coal, and natural gas. Then, Westinghouse's Joseph Nelson says, "Electric power will have to be the answer. So the question becomes, what is the most efficient device we can put on electric power? The answer is the heat pump."

In making my own decision as to what plant would be best for my house, two big negatives remain: that awesome initial cost and the lack of qualified servicemen.

And this last, the scarcity of good men, should be perhaps the *prime* consideration for most home owners. Says International's Shelton: "Up to now the situation has been horrible. People have jumped from being ordinary sheet-metal mechanics, who have installed only a dozen or so air conditioners, to heat-pump experts—with disastrous results."

Fortunately, in my case, the two local men are quite competent. One, Don Van Buren, says, "I like the convenience—no fuel to be concerned with. And the cleanliness. And with this energy crisis coming—well, they're sure as hell not going to turn off the electricity. Even if it does cost me a little more to run because of the high rates here, for how long, if oil prices keep rising?"

Heat pumps aren't for everyone

If you're not interested in air conditioning, if no maintenance people are near, if you live in Alaska, forget it. But if you are thinking about going electric anyway, you should at least consider a heat pump. And if you do, you might check out these things.

- What does your utility company say? Some are enthusiastic. Some aren't at all. Some have a maintenance underwriting program. Most will send a man out to do a survey of your home and work up an annual cost estimate.
- Look at your house. Well insulated? Too small? (An apartment might be adequately served by a one-ton unit for cooling, but there are no certified models in this size.)
- Check your local expert. How many units has he put in? Talk to some of his heat-pump customers.

I still feel a heat pump is sort of a gamble. But I'm going to take it. Ask me in three years if the decision was the right one. PS

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Beginning Here: Special 10-Page Home Heating Section

Beating the Energy Crisis: More Heat from Less Fuel

It's time to get your furnace—and house—in top shape. It could be a long, cold winter

Heating your home takes a massive bite out of our nation's energy supply. In fact, keeping your family and the millions of other families in the U.S. warm accounts for 14 percent of the country's fuel bill.

Furthermore, the shortage of gas and oil is driving prices in the direction of Skylab. Worse, fuel won't be available in some areas at some times this winter at *any* price. The tanks will be dry. That's what happened last year in many areas of the Midwest. Schools, churches, and factories had to close because of a lack of No. 2 fuel oil. Homes have top priority and will get whatever oil there is again this winter. But if the situation gets worse this season, some homes—maybe yours—may run short of oil, gas, or electric power for heat.

New research on how to conserve energy will help in the future. The government's General Services Administration, for example has announced plans for a new Federal Building in Manchester, N.H., that would, says the journal of the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) "provide a laboratory for the installation and measurement of both recognized and innovative energy conservation techniques/equipment." Heating technology will get high priority.

Also underway is a Princeton University study of energy use sponsored by the National Science Foundation. Researchers are checking design factors and life-style variables in an entire community. Their aim: to find out just how people use energy and what can be done to save it by changing use habits and by building differently. Project co-director Richard Grot, for example, feels that high air infiltration may account for up to 30 percent of the heat loss in a typical dwelling in their guinea-pig town of Twin Rivers. If so, a series of relatively simple fixes can save money.

Some changes already have been put into effect on the national level. The Federal Housing Authority has toughened its minimum standards for new homes to give greater energy-use efficiency. Maximum heat loss is now half what was allowed in 1965. If you move into a new house this winter, you get a head start. You should expect a better-insulated, more tightly sealed house than before. FHA requirements may eventually get stricter.

ASHRAE—whose theme this year is "save energy"—is hard at work on new building standards of its own. And not all the attention is being focused on new construction. ASHRAE engineer Nick LaCourt says, "We hope to make specific recommendations—in new and *existing* housing—to improve engineering design without deviating from our comfort standard."

But what can you do for your present home—this winter?

If your furnace is old, inefficient, and a fuel gobbler, this might be the time to buy a new one. But even without such a drastic move, you can probably cut your fuel use by 10, 20, or even 50 percent—depending on your present heating efficiency.

The next nine pages give you the specific information you need to tune your furnace and heat-delivery system to peak efficiency, add insulation in problem areas, stop air infiltration with the type of weather-stripping most appropriate to your home, and so on.

One final thought. For years, most heating experts have advised that you improve insulation, add storm windows, and perform similarly expensive alterations only if they saved enough money to pay for themselves in a reasonable period of time. And frequently it was cheaper to simply burn more fuel.

That was in the age of cheap, abundant fuel—an age we will not see again for many years, if ever. So today, that type of thinking is out of date. And fuel costs are going up so fast that some experts say almost anything you do to save fuel will pay for itself—if not this year then next year or the year after as heating costs soar.

Perhaps even more important, there will be times when fuel becomes scarce, possibly unobtainable for certain periods of time. When that happens, the homeowner who can nurse the most days of heating out of a tank of fuel will stay warm—while other furnaces around him sputter out.—*The Editors*

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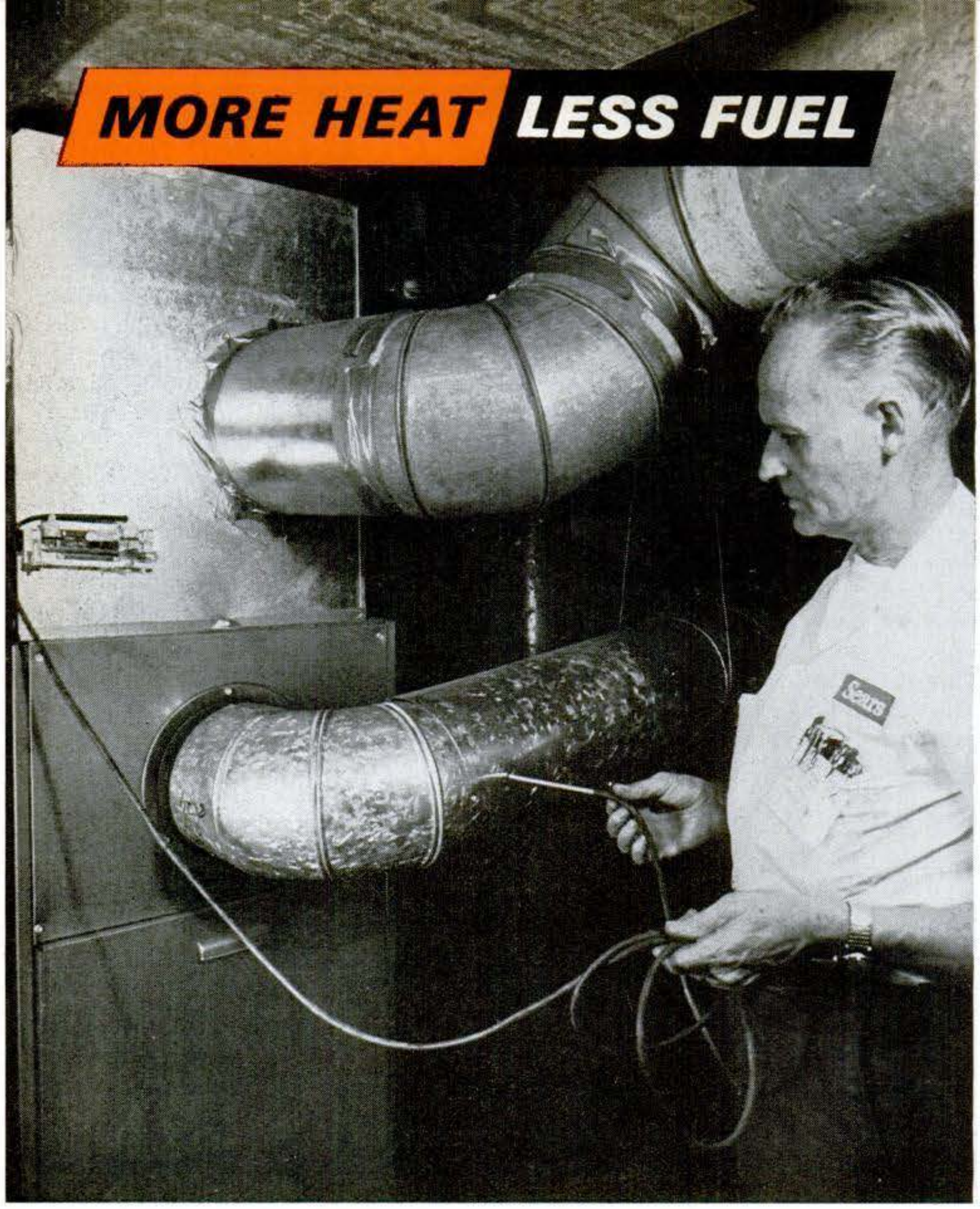
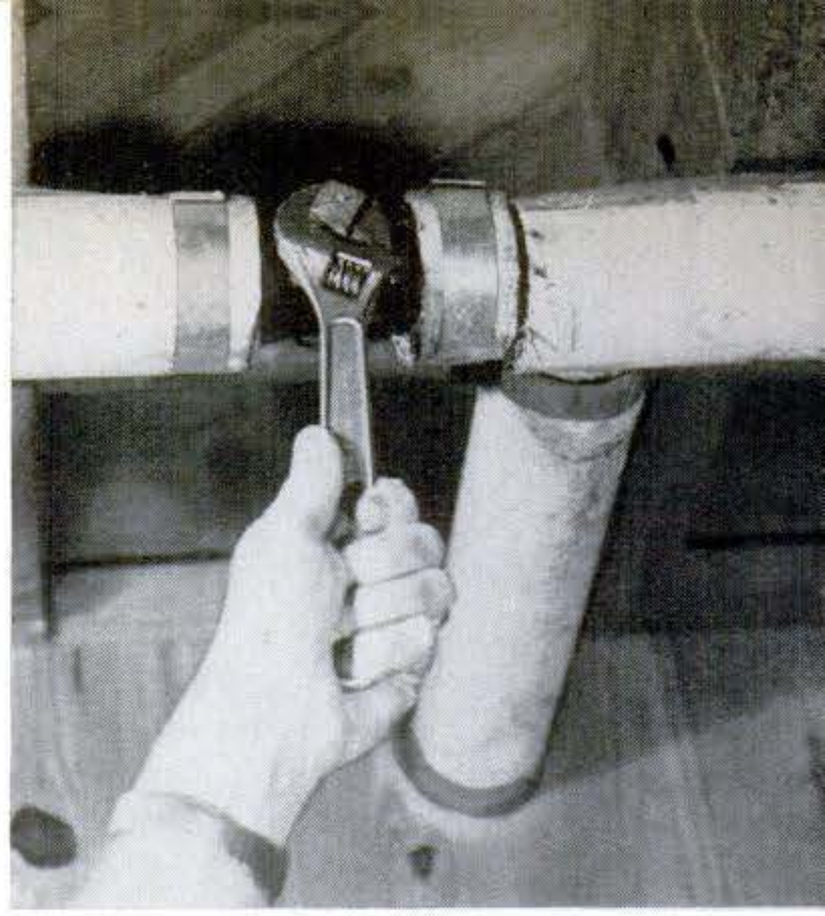
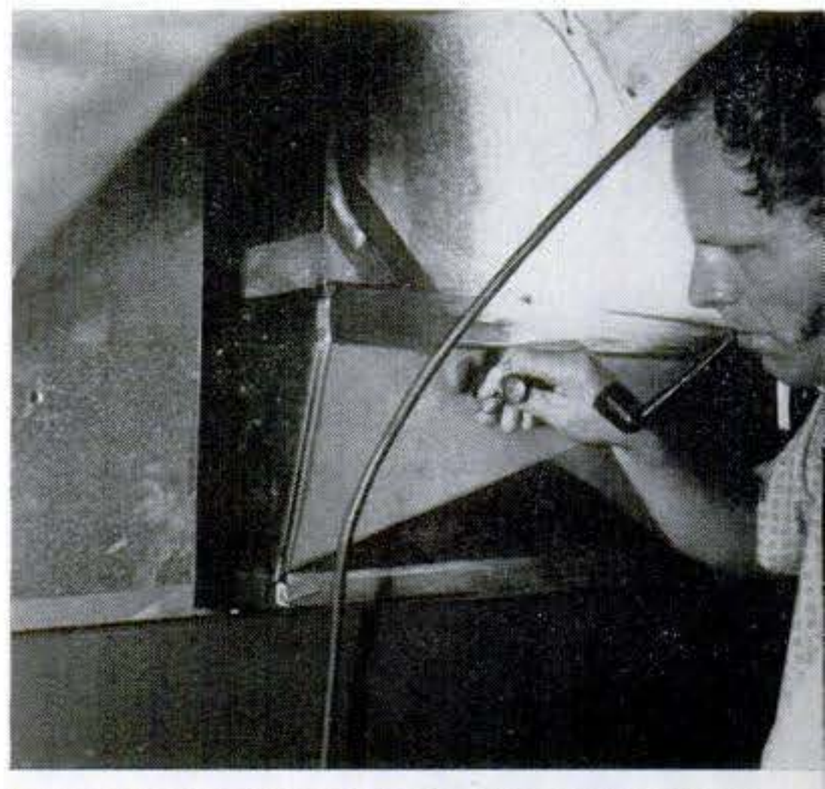


Combustion testing is a procedure for experienced heating technicians only, but there's still plenty you can do to put your heating system in peak form. Combustion testing involves checking draft and stack temperatures, sampling flue gases for CO_2 and soot. All this requires specialized test equipment.



Balancing your heating system is one job you can do better than a technician. On hot-water systems you balance via valves that regulate flow to radiators.



Checking temperature rise across heat exchanger is another job you can handle. You'll need to drill holes in return and supply plenums. Tape shut when done.

Tune Your Heating System

Your present heating system can warm you through the energy crisis if you help it make the most of its fuel

No doubt about it. The newest heating systems will give you more heat from a given amount of fuel than their predecessors. But unless you're ready to invest in a whole new plant, your best bet for getting through the coming winter in comfort is to put your whole system—from burner to registers to thermostat—in top working order.

Start with the distribution system. If you're using a hot-water system, the piping and radiators or convectors form your distribution center. If you have electric heat, the radiant panels or baseboard heaters are a distribution system of sorts. Forced-air systems have their ducts and registers. No matter what type distribution system your heating plant uses, it can likely be improved.

First step: balancing. Experts often use expensive and complex instruments to balance a home heating system initially. But only you can tailor the balancing of your system to your personal needs. It requires no equipment at all; it's a trial and error procedure and may take several weeks to get the adjustments set exactly to your liking. Once they're set, however, you mark the control positions and they're easily reestablished when the next heating season arrives.

Balancing is simply the concept of adjusting the temperature on a relative basis. Thinking in relative terms, go into each room in your house. Try to determine how you may reduce the amount of heat input into any particular room. For example, many people find the bedrooms more comfortable when they're cooler than the primary living area of the home. If you agree, then here's a good place to begin saving fuel. Maybe you don't mind throwing on a couple of extra blankets on cold nights. It's often desirable to keep game rooms and workshops much cooler than other rooms because of the heavier activity in these areas. Upstairs rooms can often be limited in heat input because downstairs heat will rise up stair wells and even through floors to help heat the upper area.

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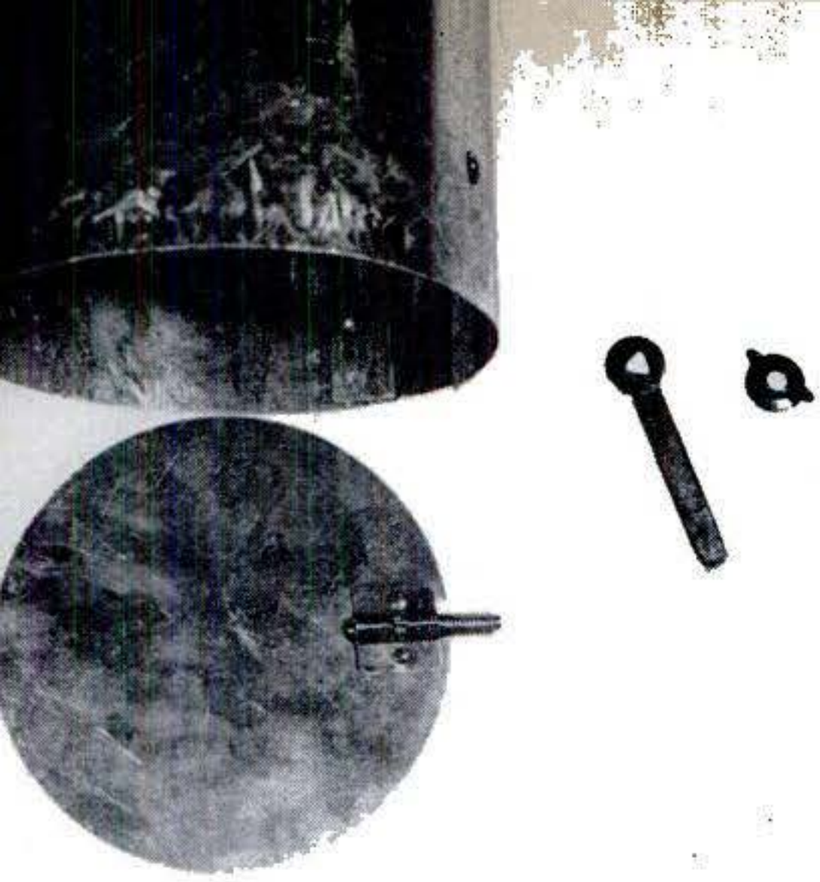
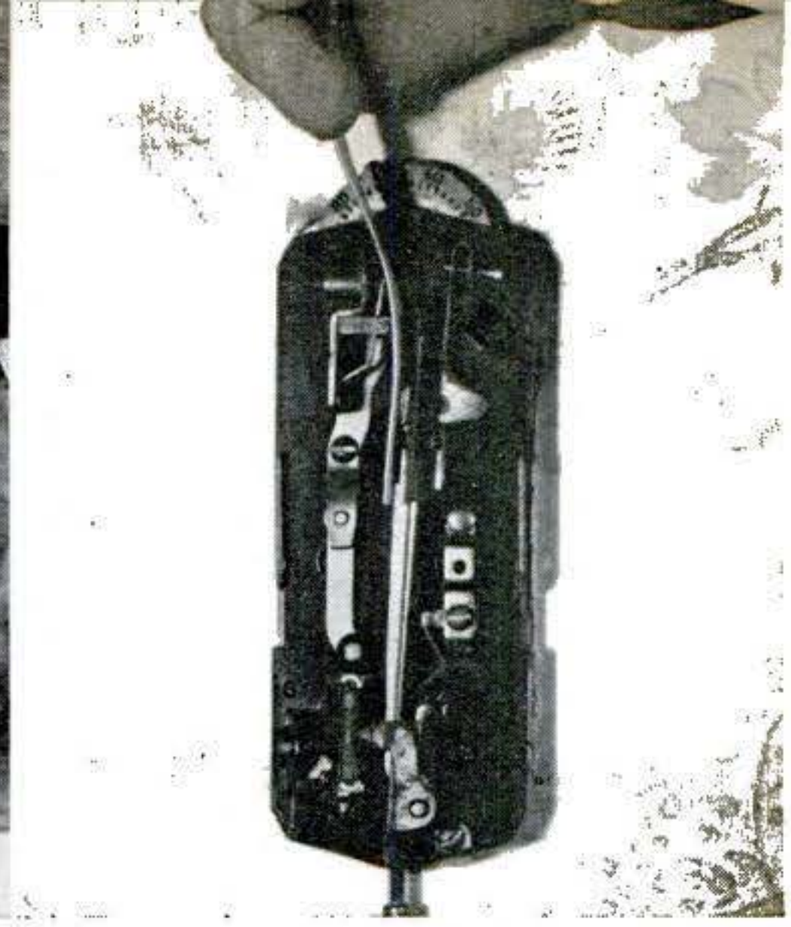


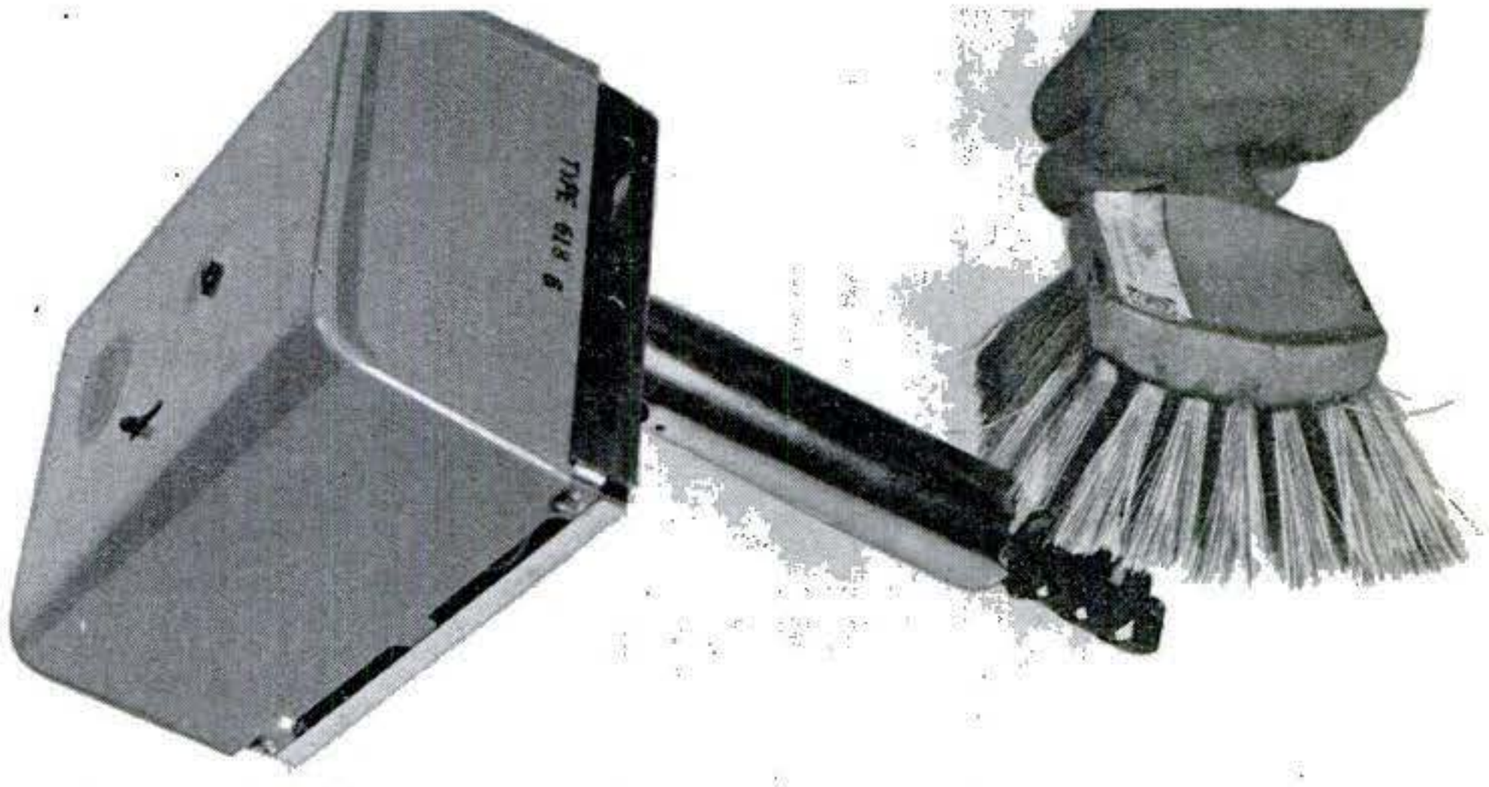
Hot-air systems can be balanced via dampers in air ducts. If your system has none, they're easy to install. Diameter must correspond to that of duct.

Humidifier is practically mandatory to maintain comfort at lower temperature levels. Well-designed kits let you do the installation yourself.



To clean points, a thin piece of paper can be pulled between contacts on bimetal thermostat. Never lubricate the pivot points of thermostat controls.

You adjust heat rise by turning a special pulley to change its diameter. This in turn changes the blower speed. Higher speed means lower heat rise.



Primary control on many oil burners is located by means of a probe inserted into smoke stack. Remove the control and brush soot from helix at the same time you clean the furnace. Primary control is easy to identify. Look for the reset button on front cover. It will be labeled with the word "reset".

to Peak Efficiency

By EVAN POWELL

Rooms located close to the furnace will have shorter duct or piping runs. Throttling these short runs helps to force more water or air into the long runs, heating other areas of the home with the heat previously wasted.

Hot spot: the kitchen. The kitchen will probably win top honors for fuel savings. Lots of heat flows into this area the year around—heat from the condenser of a refrigerator or freezer, from the dishwasher and the range. Don't be surprised if you turn the heat entirely off in the kitchen area and still find it plenty comfortable.

The actual mechanics of carrying out the balancing job can vary greatly. First, be sure that there are no obstructions to heat flow such as chairs, carpet, and drapes blocking registers or baseboard heaters. If you have individual room controls, as many electric heating systems do, you just turn down the control until a comfortable level is reached. With a hot-water or forced-air system, you must adjust the amount of heat being carried into the particular area from the main system. While this can be done by simply closing valves at radiators and closing registers, it's not the most efficient way. It's far better to go back as near as possible to the heat source—normally at the trunk line feeding that part of the house.

A trunk line is a large duct or water line that leads from the furnace to supply several rooms with heat. From this main line, there'll be smaller branch runs, like limbs on a tree. Ideal is to be able to reduce the flow of air or water by closing a damper or a valve located adjacent to the trunk line. If valves are not provided in a hot-water system, they can be expensive and difficult to install; then your best course would be to use the valve at the radiator to adjust water flow and heat input. Dampers in a forced-air system, however, are inexpensive and fairly easy to install—as long as the branch runs are accessible.

Maintaining the system. Take a close look at a hot-water system for signs of leaking or rusting at pipe joints. A sample of water taken from the furnace will tell you if there is rusting. Large flakes of rust may indicate serious problems. If you find such symptoms, contact your servicing dealer for an expert evaluation.

Continued

MORE HEAT LESS FUEL

Check the pump coupling, and lubricate the motor and pump with manufacturer's recommended lubrication (usually SAE 30) if oil ports are provided.

Owners of hot-air systems should be particularly careful to change filters at frequent intervals—at least every 30 days. Clogged or restricted filters are a primary cause of impaired efficiency. If the blower chamber of the furnace shows evidence of a great deal of lint or dust, it might be wise to remove the access panel of the squirrel-cage blower and clean the blower wheel thoroughly with a small brush and a vacuum cleaner.

The motor should be lubricated; belts on belt-driven equipment should be checked. Belts should depress about ¾ inch with light finger pressure midway between motor and blower pulleys. Be sure all power is turned off to the furnace before removing panels.

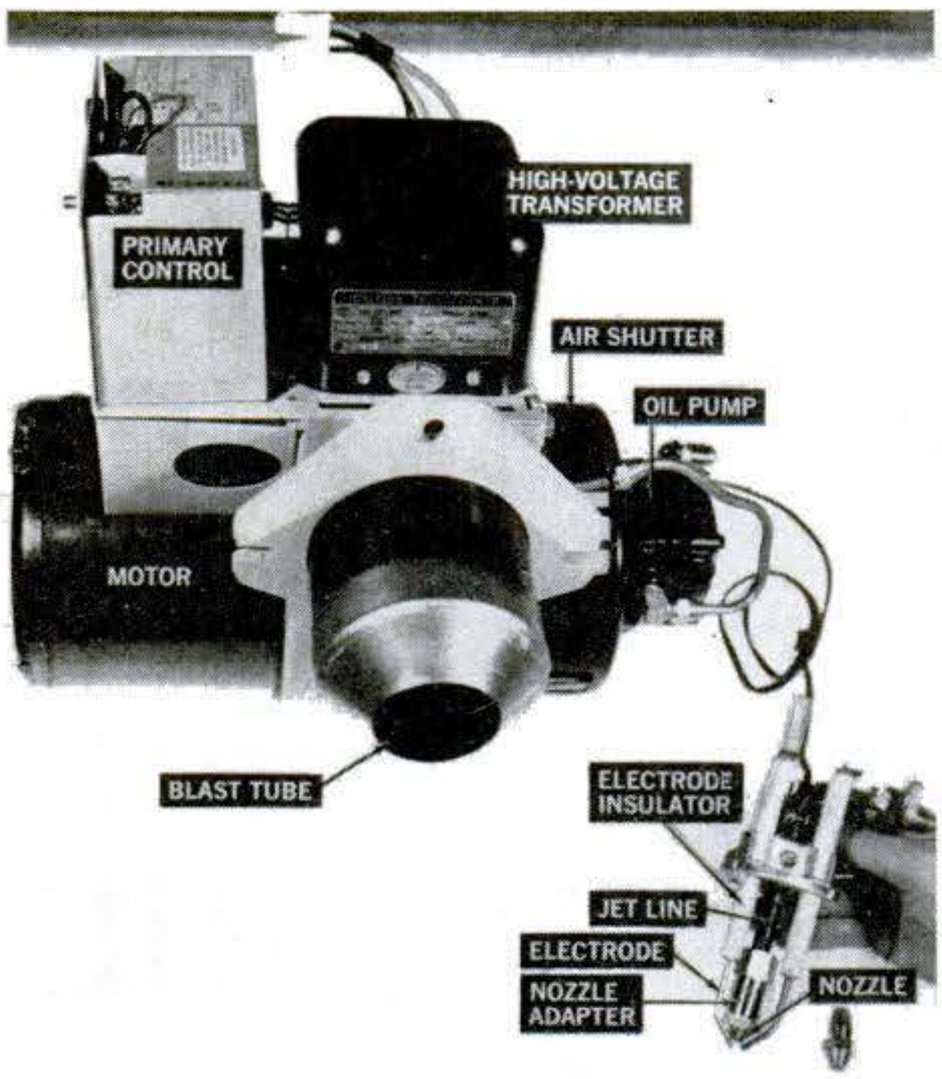
How an oil burner works

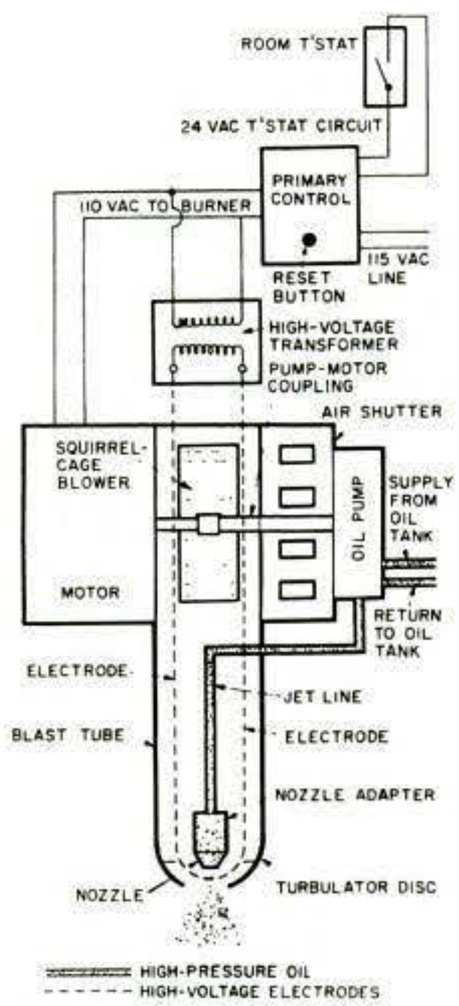
The electrical supply is fed into the primary control from a 115-volt circuit at the entry panel. The limit control is often placed in this line also. A built-in transformer supplies a 24-volt control circuit to the room thermostat and to the safety shutdown circuitry. The safety circuit may be actuated by a heat-sensing bimetal located in a flue passage, or by a light-detecting cell which sees the light of the combustion flame. In either case, the burner shuts off in the event of flame failure, and in addition, a safety delay is incorporated to prevent firing the combustion chamber when it is hot. When actuated, the primary control provides 115-volt current to the burner motor and to a high-voltage transformer. The high voltage arcs between two electrodes, above and slightly in front of the nozzle. This ignites the oil spray.

The motor shaft is coupled to a blower and to the oil-pump shaft. The blower forces air through the blast tube where it is twisted through a turbulator disk before it exits to mix with the oil spray from the nozzle. The oil pump forces oil at high pressure through the jet line and nozzle. The nozzle is engineered to provide a consistent spray pattern.

Any deviation in spray requires nozzle replacement. The oil-line filter should always be changed at the same time. Correct air/oil balance is obtained by moving the air shutter. This should only be done by a qualified technician with combustion-test instruments. Flame will normally—but not always—be bright yellow with slightly orange tips.

Excess oil is returned to tank through second oil line. Above-ground tanks may use single line. It then becomes necessary to purge air from pump before burner can be restarted if tank runs dry.





Oil-furnace gun here, has been taken from furnace for demonstration. Firing head has been removed from blast tube for clarity. Nozzle at bottom is a spare.

Thermostat in top shape? It can have a direct and substantial effect on fuel consumption. But it's not just a simple matter of turning it down five or seven degrees. First, check to determine if the thermometer on the thermostat is accurate enough to give a fair temperature reading. This is done easily by comparing it with a thermometer known to be accurate. Thermostat thermometers can be adjusted by moving a small allen screw on the bimetallic type or by loosening a tab and sliding the sealed glass tube up and down on mercury-type thermometers.

Also, since most thermostats in use today use a sealed mercury bulb as a switching device, it's important that they be correctly leveled. Do this by placing a level on a flat spot which is usually provided at the top of the thermostat body or at flattened tabs located under the thermostat cover. Loosen the screws that attach it to the wall and adjust the thermostat to either side until it's level. Then retighten the screws.

Take a close look. See just how your thermostat operates. If it uses a switch contact rather than a mercury bulb, clean the contacts slightly with a piece of notebook paper. This helps remove dust and burnishes the delicate contacts.

Your inspection of the thermostat will likely reveal a small device called an anticipator, which may be altogether strange to you. It's a separate scale and pointer within the control, with longer and shorter burner-cycle operation indicated. The anticipator uses a small amount of heat from the current flow that passes through the thermostat as it controls the furnace relays or valve. This small source of additional heat allows the thermostat to compensate for the overrun of the blower when the furnace cuts off, when the heat that has been absorbed by the heat exchanger continues to radiate into the circulating air after the burner or elements have shut off.

The anticipator must be set correctly. To do this, simply follow the small low-voltage thermostat leads into your furnace. There they will connect to a control called the primary control in oil burners or to the main gas valve on a gas furnace. Removing the cover of this control, you'll find a name-plate tag that lists the current consumption of the thermostat circuit, stated in tenths of an ampere. Set the anticipator to this rating by sliding the pointer to the number corresponding.

Add a humidifier. This is essential for two reasons: maximum comfort and maximum benefits from lower overall temperature in the home.

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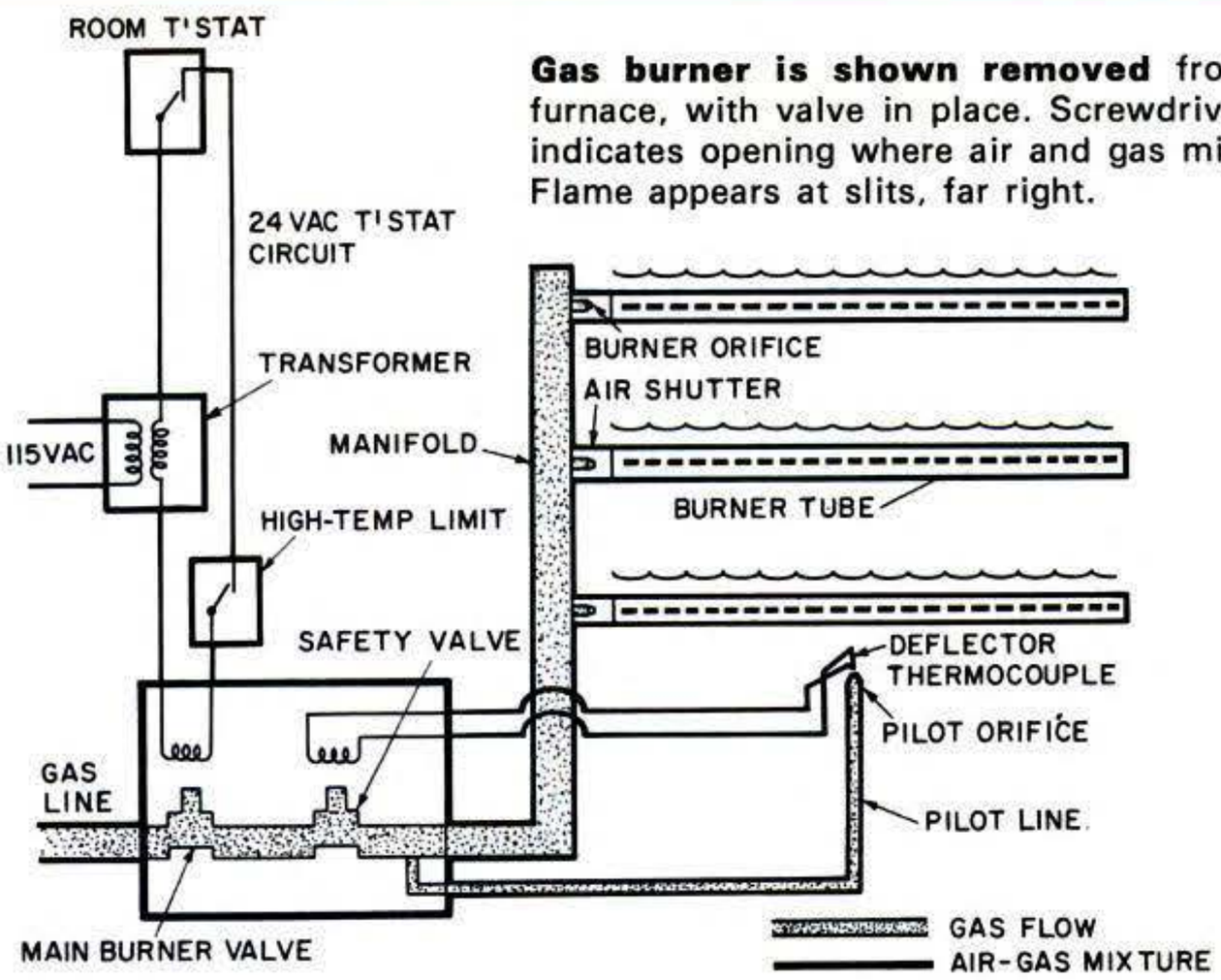
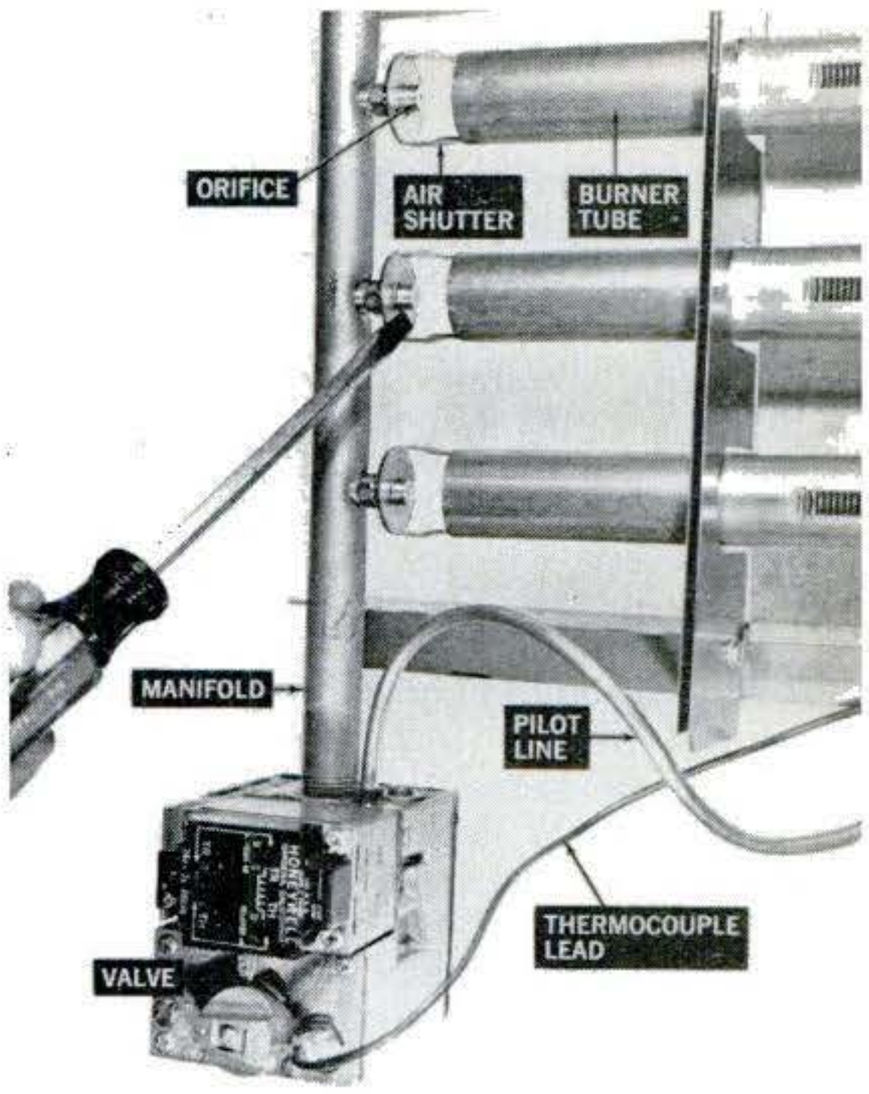


Gas burner is shown removed from furnace, with valve in place. Screwdriver indicates opening where air and gas mix. Flame appears at slits, far right.



How a gas burner works

Electrical supply lines usually lead to a low-voltage transformer mounted on or near the furnace. The 24-volt output is fed through the room thermostat and the high-temperature limit switch before energizing the gas valve. Two limits are often used—one in the 115-volt line, and an auxiliary in the 24-volt circuit.

A safety circuit is provided by a thermocouple that is part of the shield or deflector mounted directly over the pilot-light flame. The heat from the pilot light acting upon the thermocouple generates a tiny electrical current, which is used to hold a second valve open within the body of the gas valve. Failure of the pilot flame cuts this current and the gas is shut off. Holding down the pilot button opens the safety valve manually for lighting the pilot. Both pilot safety valve and main burner valve must open for the burner to operate.

When valves are open, gas flows through the main valve and through the safety valve to the manifold and to the pilot line. The pilot flame is directed to the burner tube of the adjacent burner, and this burner in turn ignites the others. As the gas flows from the orifices, it mixes with air in the burner tube. The number of burner tubes and sizes of orifice openings vary, depending on the model and output of the furnace.

In a forced-air heating system, a humidifier is easily installed in the supply plenum or chamber of the heating plant. With electrical or hot-water heat, place a portable (or built-in) unit within major living areas.

Even under the best conditions, moisture levels suffer when air is heated to room temperature during winter months. Nasal passages and body membranes become dry, and the evaporation rate of moisture from the skin is greatly increased. Since this makes us feel cool, the first inclination is to turn the thermostat up a notch or two.

By adding moisture to the air, the humidifier overcomes the "cold seventies" problems, allowing us to reduce the temperature and still remain comfortable. The humidistat control should be set between 30 and 40 percent relative humidity (lower during periods of extreme cold). [See "How to Install and Maintain a Humidifier," PS, January '73.]

Thermostat economy. Now you're ready to roll the thermostat back from normal levels. But don't go too far—chances are the next night you'll have it turned up higher than ever. Rather, take this approach: Turn the thermostat down two degrees and leave it in this position for 48 hours. Then, drop two more degrees. Before long you'll find the lowest level that's comfortable for you. You may be surprised to find that this is probably around 65 to 68 degrees or even lower. In England, Iceland, and the Scandinavian countries, the average room temperature is kept in the lower 60s, but they compensate by wearing heavier clothing than we're accustomed to indoors. If you don't object to this, there's no reason that you can't do the same.

Continued

Ten steps to cope with the energy crisis

- ☐ Check all registers and grilles for rugs, chairs, tables or drapes that can restrict free air movement.
- ☐ Balance the heat-distribution system according to your needs.
- ☐ Add a humidifier. This makes a big difference in the comfort level of an area for a given temperature. Extra humidity makes you feel warmer at lower temperatures. But check for vapor barrier first.
- ☐ Turn thermostat down two degrees every other day until you reach the lowest possible comfort level. You might be surprised to find it at 68 degrees or even lower.
- ☐ Consider insulating air-supply ducts. Also, check quality and amount of insulation in walls and ceilings.
- ☐ Check and seal all points where air enters the home. Check and repair or add weatherstripping around doors and windows. Consider the installation of storm doors and windows. Close fireplace damper when not in use.
- ☐ Consider installation of additional or oversize oil tank.
- ☐ Clean combustion chambers and flue passageways (and chimney if necessary). Provide adequate air for combustion in furnace.
- ☐ Tune the burner and have combustion tests made. Set controls for maximum efficiency. Have oil-line filter element changed.
- ☐ Change or thoroughly clean air filters at least once a month. Check and adjust blower belt (if so equipped) at beginning and middle of season.

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MORE HEAT LESS FUEL

Remember that every degree reduction means a significant saving in fuel. Once you've reached the lowest temperature at which you can be comfortable, touch up the balancing of the house. By now you have probably reduced heat input considerably and accomplished quite a savings in fuel consumption.

How about the "nighttime setback?" There's a lot of controversy about this question. At a recent meeting of the Hydronics Institute, two authoritative speakers voiced widely differing statements on the subject. But the most recent research—an analog computer study conducted by Honeywell, Inc.—indicates that under normal conditions, nighttime setback of thermostats does indeed conserve fuel energy.

If, after balancing and reducing the overall heat you still want to set the thermostat back at night, fine. But don't give it priority over the other procedures.

What about health aspects? Of course, if you suffer from chronic respiratory ailment, or if there is a baby in the house, check with your physician before reducing temperatures below "normal" level. But otherwise, the physicians and medical experts whom I've questioned voice no objection at all to lowering average temperatures significantly in the home, and most were enthusiastic about the benefits of humidification.

Tuning the heating plant. This brings us to the primary source. To check the operation of electric heat sources, you're rather limited. About all you can do is turn off the power and check all connections. Be sure that there are no restrictions to free air flow around the heating units or grilles; with a volt-ohm meter, check to see that voltage drop is no more than 10 percent with the unit in operation. But if you burn oil or gas, there's probably quite a bit of room for improvement, much of which you can do yourself if you have the necessary information.

What you can do. Cleanliness is important. The carbon accumulation inside combustion chambers and flue passageways acts as an insulator. Only ¼ inch of soot accumulation can reduce efficiency 20 percent. Removing it is not a "fun" job. You'll have to take the smoke pipe down and, with an old vacuum or shop vac, clean the passageways thoroughly, using the crevice tool or hose to "scrub" the inner surfaces. Don't attempt to vacuum the combustion chamber of furnaces that have a fibrous lining [PS, Sept. '65]. This fragile material, easily recognized by its fabric-like appearance, as opposed to stainless steel or ceramic (fire bricks), has several advantages—one of which is that it rarely needs cleaning. Replacement kits are available for many older furnaces.

Most of the flue passageways can be reached through the opening where the smoke pipe or exhaust vent leaves the furnace. Although some new chemical cleaners have been developed that remove an appreciable amount of carbon without overheating the furnace interior to burn it away, vacuum cleaning the furnace interior is still the most thorough and safest method.

If yours is a warm-air furnace, adjust the blower speed to obtain the recommended air temperature rise across the heat exchanger of the furnace. To measure this, drill a small opening in each of the two chambers where the ducts originate on the warm-air furnace. After the furnace has been in operation for several minutes, place a thermometer in one chamber, note the reading, and then obtain the reading from the opposite chamber. The difference between the two readings is the air temperature rise. Consult manufacturers instructions for correct readings.

For a gas-fired furnace, the maximum rise in most installations should be 100 degrees F, the minimum rise, 70 degrees. With an oil furnace the maximum rise should be 100 degrees, the minimum 60 degrees. And in an electric furnace the maximum rise

[Continued on page 172]

Convert to continuous air circulation

A serious waste of fuel occurs in all start/stop forced air systems. When the fan is off, all circulation stops. Warm air rises and stacks up against the ceilings—the largest area of heat loss in most homes. Cold air settles down to floors where children play.

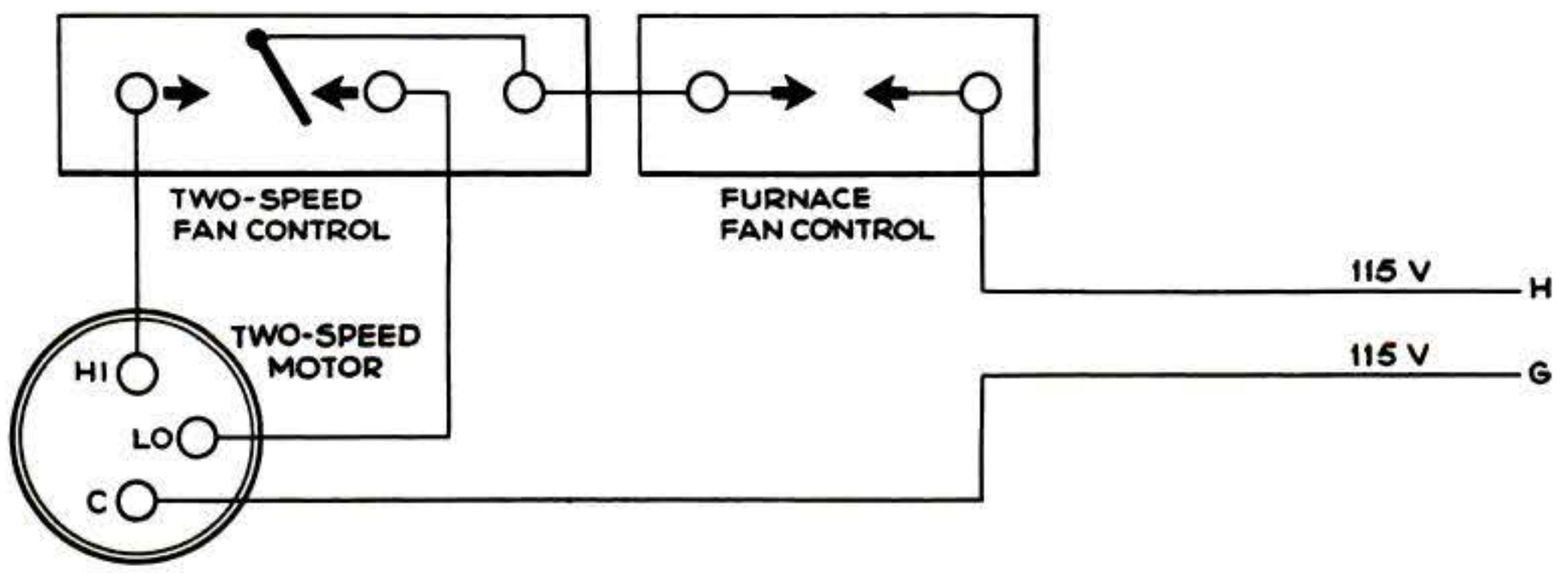
Continuous air circulation (CAC) solves these problems. And it solves them best if the CAC fan is two-speed. The fan works at high speed while the furnace is heating, then drops to low speed when the heat shuts off. The low speed provides enough circulation to prevent stratification, but not so much that you feel a cool draft. In this way, CAC contributes to fuel economy by reducing your impulse to boost the thermostat during heat-off periods. You also take full advantage of sun-warmed rooms, since air is distributed evenly to other parts of the house. And CAC gives you fuller benefit of air cleaning and humidification devices built into your system.

How to make the conversion: The average installation takes from half an hour to three hours and costs around $50 for a new two-speed motor and control—assuming your blower is belt-driven.

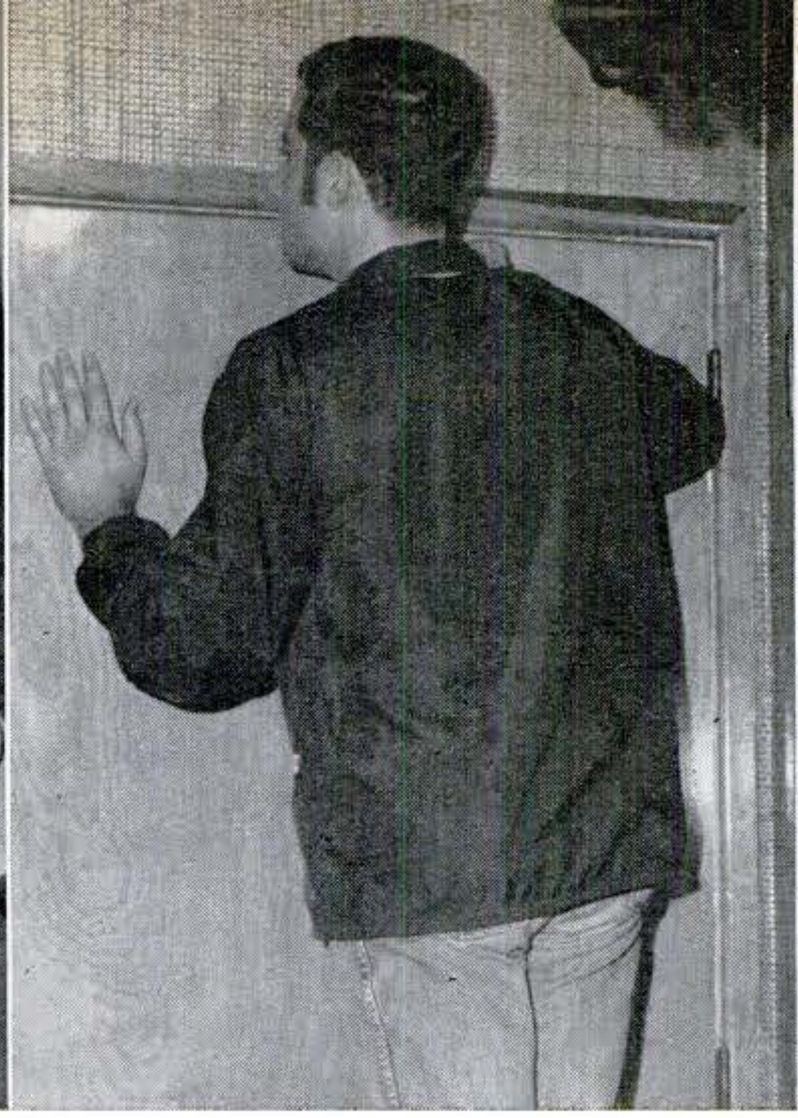
Match the new motor's full-speed power, shaft diameter, amperage, and frame to the one you're replacing. Check this by shutting off all power to furnace and removing cabinet panel at blower/filter compartment. Mark direction of blower rotation on housing. Buy a SPST fan control for dual operation and adjust top speed to 85/100-degree furnace heat.

Disconnect and demount old motor, remove variable-pitch pulley from its shaft and attach to new motor shaft. Fasten new motor to mounting plate, check alignment with fan pulleys, replace drive belt and adjust tension. Connect and turn on power to check blower rotation. Turn off power and replace old thermal control with new fan control, wiring per maker's diagram and local codes. That's it.

The double-wound motor will now drive your fan continuously—at low speed—whenever the powerline to the furnace is on. It automatically switches to full speed as furnace temperature rises above 100 degrees, back to low speed when temperature drops. (Bonus: Summer circulation at low speed provides cooling effect.) If your furnace has a multi-speed direct-drive fan motor, consult a heating expert re CAC conversion.—*J. M. Matthewman*



[J. M. Matthewman is a heating technician for Emco Kawartha Limited, a Canadian climate control concern. Formerly Chairman of Technical Standards Committee, Nat. Warm Air Assn. of Canada, he's an authority on CAC.]



Checks and adjustments of your present weatherstripping

To locate air leaks, use your hands as a diagnostic tool. Feel around edges of window and door openings for any draft. Mark leaks with chalk for later action.

See streaks of daylight between door and frame? Door stop should be more tightly seated with additional nails—even before you apply new weatherstrip.

Adjust double-hung windows with metal channels lacking adjustment screws by bending metal lip until window holds position but doesn't bind excessively.

By LEN HORTON

FOR GREATER HEATING EFFICIENCY:

Seal Air Leaks with Weatherstripping

Another way to fight the winter's energy crisis is to seal your home against infiltration of cold outdoor air. One means of doing this is to fill all stationary cracks with a good caulking compound (acrylic latex; polysulfide, silicone, or butyl rubber —see chart PS Sept. '69).

Cracks which must remain movable, however—as around doors and windows—must be weatherstripped.

The effectiveness of weatherstripping—proven during our nation's last critical fuel shortage following World War II—was reaffirmed recently in a report issued by the National Bureau of Standards.

According to this report, effectively weatherstripped homes use 15 to 30 percent less fuel for heating than those that aren't weatherstripped.

Check for leaks first

Before rushing off to buy materials, however, check to see if weatherstripping is actually needed. Your home may have been sealed sufficiently when it was built.

On a relatively cold and windy day, run your hand around windows, doors and shoe moldings that face the direction of the wind. Wait for the wind to shift before testing for drafts on other walls. (Incidentally, an adequately sealed home will usually develop a light layer of mist on windows on the downwind side in cold weather.)

Other areas cold air can leak through are cracks around wall and window air conditioners and pull-down attic doors. Materials discussed here may be used for sealing these, too.

Once you find a leak, you have to decide what kind of weatherstrip will best plug it. Unless you're a professional carpenter, you probably won't tackle the installation of metal weatherstripping—though it's the only type that's rated permanently effective. To apply metal weatherstripping to a door, it must be removed from its frame for grooving. Door and frame are then fitted with metal strips that interlock when the door is closed.

To apply metal to a window, the sash is removed from the frame for grooving and weatherstripping; the most effective type has a spring-sash balance that springs shut to provide an air-tight seal.

The time to apply metal weatherstripping is during home construction or when replacing windows and doors. Many prehung units come with factory-applied metal strips.

Fortunately, there are many other weatherstrippings that are easier to install and less costly than metal. Unlike metal, however, none are truly permanent—though many are as effective until they wear out or until the seal must be destroyed.

To help you choose from the variety available, we've divided weatherstripping into categories according to the job they do (see chart). You'll also find effective materials for sealing cracks around overhead garage doors; if you have an attached, heated garage, this door must be weatherstripped—a simple half-hour's job with the better systems.

Adjust doors and windows

Weatherstripping won't compensate for improper adjustment of a door or window. Doors and windows should be checked for tightness before weatherstripping is installed.

If your home has double-hung windows, see that the top window doesn't creep open. A double-hung window is adjusted in one of two ways:

If the window is removable from the frame, you'll probably find three adjustment screws in one of the channels: at top, center, and bottom. Turn top and bottom screws a bit to produce a slight bow in the chan-

Continued

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Different weatherstrips for different jobs

Vinyl foam tape self-adheres once backing strip is peeled away. Just press in place so foam compresses when window closes; it's an invisible seal.

Hair felt is cheapest, but wins no contests for looks or longevity. Tack it around perimeter of windows or doors. It eventually deteriorates, flakes apart.

Vinyl-covered urethane foam is effective thumbtacked around doors. If panel isn't warped, it will do job of more sophisticated and costly weatherstripping.

Caulking cord can't be beat for sealing stationary cracks, as around air-conditioners. You can use it on windows only if they'll remain closed all winter.

nel. Then test to see if the window still creeps when closed.

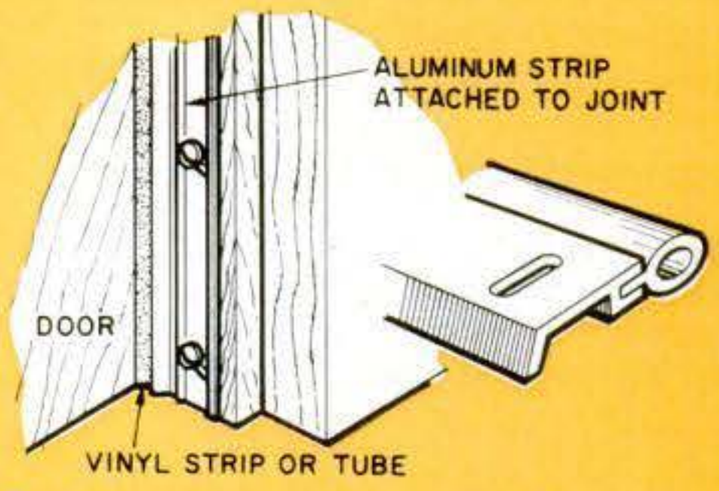
If your window can't be removed from the frame, adjust by bending the flexible aluminum lip along the length of the channel (see photo).

Movable cracks

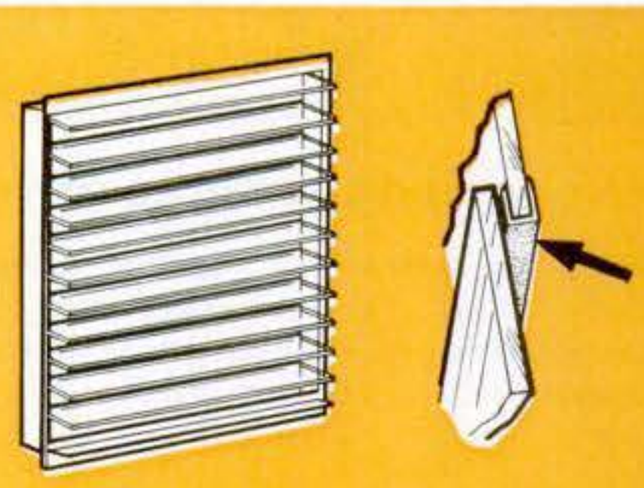
• *Self-adhering closed-cell vinyl foam tape.* The recent development of closed-cell vinyl foam has been of major significance to the weatherstripping industry. Unlike the weatherstrippings that preceded it (open-cell vinyl foam and hair felt), closed-cell vinyl foam completely blocks the passage of air.

If a product uses closed-cell vinyl foam, the package will usually say so. To test, hold the coil of weatherstripping to your mouth and blow tobacco smoke through it. Closed-cell vinyl will hardly let a wisp pass.

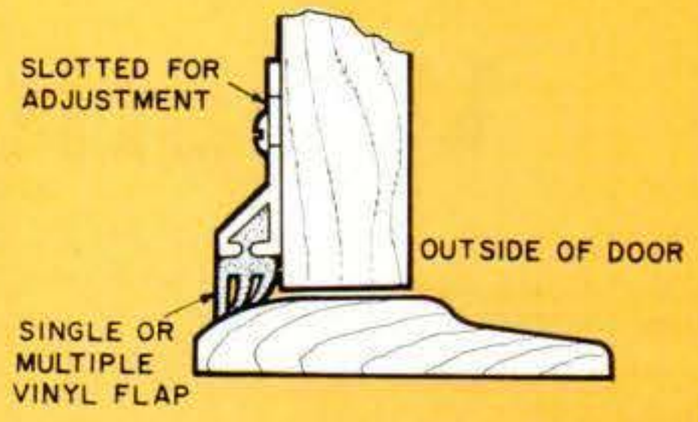
As self-adhering tape, this foam is an effective weatherstrip for the top and bottom of double-hung windows and at the top and sides of doors that are not warped.



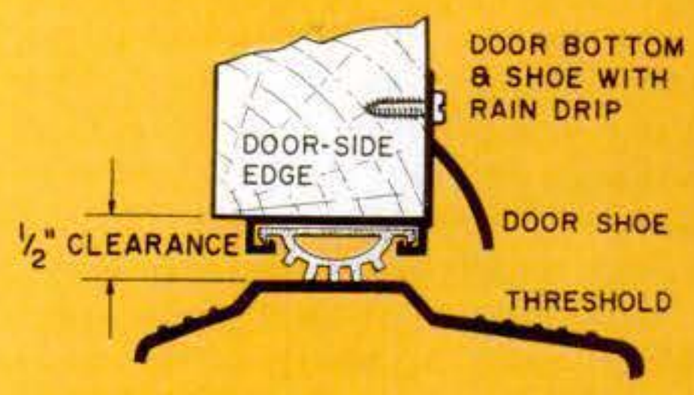
Combination strips—vinyl foam or tube attached to aluminum or wood mounting strips—can effectively seal warped doors. But they cost more.



Snap-on channels are designed to seal jalousie windows—bad air leakers. Similar type seals casements, though good ones have built-in weatherstrip.



Door sweeps are least expensive type of door bottom, easiest to install. They need adjustment for wear, though —especially the single-flap version.



Threshold door bottoms are most effective, hardest to install. You must remove door for trimming, may even have to replace existing threshold.

FACTORS IN CHOOSING WHICH WEATHERSTRIP FOR WHERE

Type	Ease of application	Effectiveness	Relative cost	Longevity	Appearance (where exposed)	Where applied
Closed-cell vinyl foam	Excellent for self-adhering tape types	Excellent	Moderately expensive	Good	Fair	Doors (top & sides) Windows (top & bottom)
Vinyl-covered polyurethane foam	Good (must be tacked)	Good	Moderate	Good	Fair	Doors (top & sides, mainly)
Combination kits (vinyl foam on wood strips or rolled vinyl in aluminum strips)	Good (must be nailed or screwed)	Excellent	Expensive	Very good (but see text)	Good	Doors (especially when warped)
Hair felt	Good (must be tacked)	Fair	Inexpensive	Poor	Poor	Doors (top & sides) Windows (top & bottom)
Cord caulking	Excellent	Excellent	Inexpensive	Excellent	Can be painted	Stationary cracks

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Closed-cell vinyl foam tape is vailable in several sizes for various ize cracks. Cost ranges from 75¢ to 1.60 per package, depending on size. package is enough to do about ne door or two windows.

• *Hair felt.* Hair (or wool) felt is e oldest weatherstripping on the arket—it survives because it's heap. It comes in several shades: rown, black, and grey. But since remains visible when installed, it ould be considered an eyesore.

The material is fairly effective as ng as windows (in particular) ren't opened and closed too much, hich tends to wear away the felt. ut it eventually deteriorates. One rm of hair-felt weatherstrip has errated metal on one side, making more sturdy.

Cost of hair felt ranges from about 9¢ to 99¢, depending on size and uantity. The cheapest package proides enough for one door or two indows, and the more expensive ne gives you enough to do about hree doors or six windows.

• *Vinyl-covered polyurethane oam.* This is a polyurethane foam trip wrapped in a vinyl cover. It an be purchased in various thickesses from four to 16 mils, either in ackages (standard package has nough material to weatherstrip one oor or two windows) or off rolls arried by home-supply dealers. It uns about 60¢ for an 18-foot length.

As with hair felt, the strip remains xposed, which may prove objecionable. However, it does make an ffective weather seal, especially round doors. For windows, its abilty to seal off air infiltration is reuced as the window is opened and losed. In other words, once the seal s disrupted, effectiveness is reduced.

[Continued on page 162]

Hinge its own weatherseal

Revolutionary new continuous hinge with gear-mesh pivots locked in a arrel channel that runs the full height of oor) makes weatherstrip unnecessary on inge side of jamb. All three sections are igh-strength aluminum extrusions. In tandard door heights from Roton Hinge iv., Allied Products Corp., 5401 W. oosevelt Rd., Chicago, Ill. 60650.

MORE HEAT LESS FUEL

Does your home have inadequate insulation? Or maybe none at all?

Add Plastic Foam to Ceilings and Walls

By GEORGE DANIELS

One of the easiest and most economical ways to add insulation to an existing home is by mastic-bonding rigid foam insulating panels to ceilings and walls. You avoid the expense and complications of adding in-the-wall insulation, and complete the job in a fraction of the time.

You use the foam on the interior surface of outside walls (don't waste it on inside walls) and on ceilings that are directly under a roof or unheated attic. You *don't* use it on walls or ceilings that have efficient vapor barriers (it would transfer the barrier to the cold side—a no-no) but few homes with poor insulation are likely to present this problem.

Where the foam is used on walls, cover it with paneling or gypsum wallboard to protect its relatively soft surface against impact. Bond the paneling or wallboard to the foam with the same mastic used to bond the foam to the walls. (This *must* be a suitable type. Label should specify usability with foam.) On the ceiling its textured white surface requires no paint. If you want another color, latex paints work fine.

The foam I used is Cellofoam, an expanded polystyrene foam made by United States Mineral Products Company, Stanhope, N.J. 07874. The panels are 1″ thick, 2′ wide, and 4′ long. Price of the 2′-by-4′ panels: 80 cents apiece. (Our two wall-application photos were supplied by Amspec, 1880 Mackenzie Dr., Columbus, Ohio 43220—manufacturers of styrofoam insulation. Write them for dealer data on this brand.)

How to use it. On walls, I start from a corner, and mount the first course vertically, then cover the rest of the wall horizontally. When paneling is mounted over this foam (starting from the original corner) its edges won't meet at foam edges.

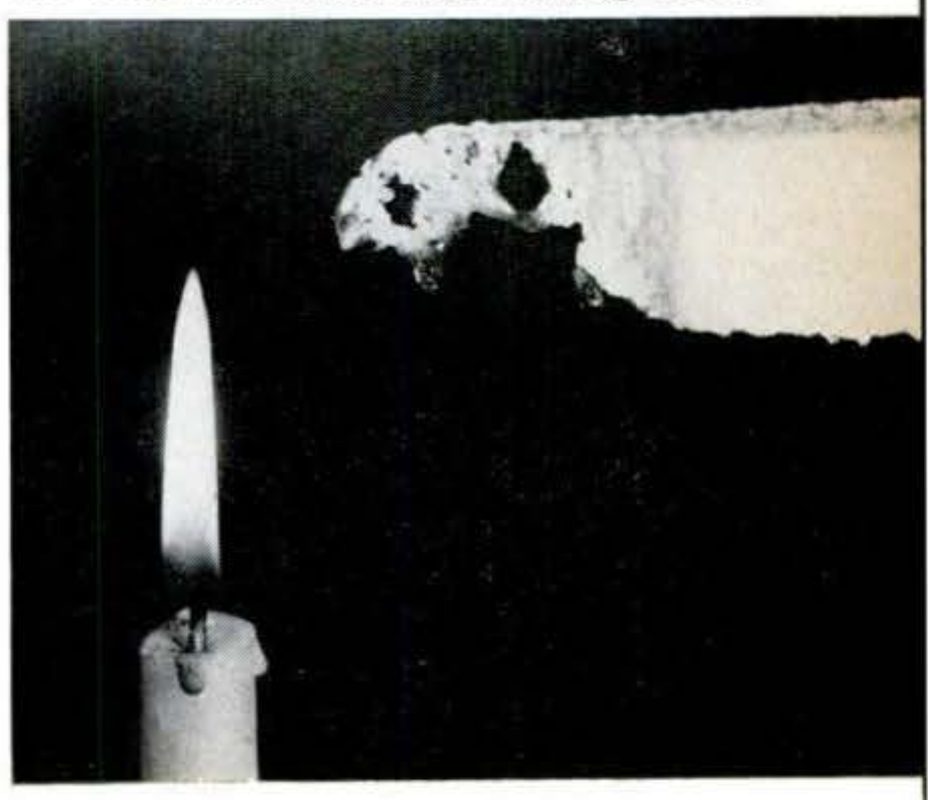
At windows and doorways give the foam a trial fit "dry," and trim as needed before applying the mastic. When mounting the foam after applying mastic, I give it a slight sliding movement to assure a firm bond. A fraction of an inch will do.

At windows, you may have to widen the stool (inside sill) with a nailed and glued strip. The apron

Continued

Will it burn?

If you read the papers you probably know about the controversy over fire and foam. What's the truth? Some foams are dangerous, others aren't. The Cellofoam used here has been classed as "self-extinguishing" (new regulations may result in a new term): Apply a flame to it, the foam will burn (or melt); remove the flame, the foam goes out, as below. Before using another type of foam, test it. If it stops burning when you pull it back from flame, no problem (most wood isn't that safe). Fumes? Animal tests indicate Cellofoam's (while flame is applied) are less toxic than those from burning wood.



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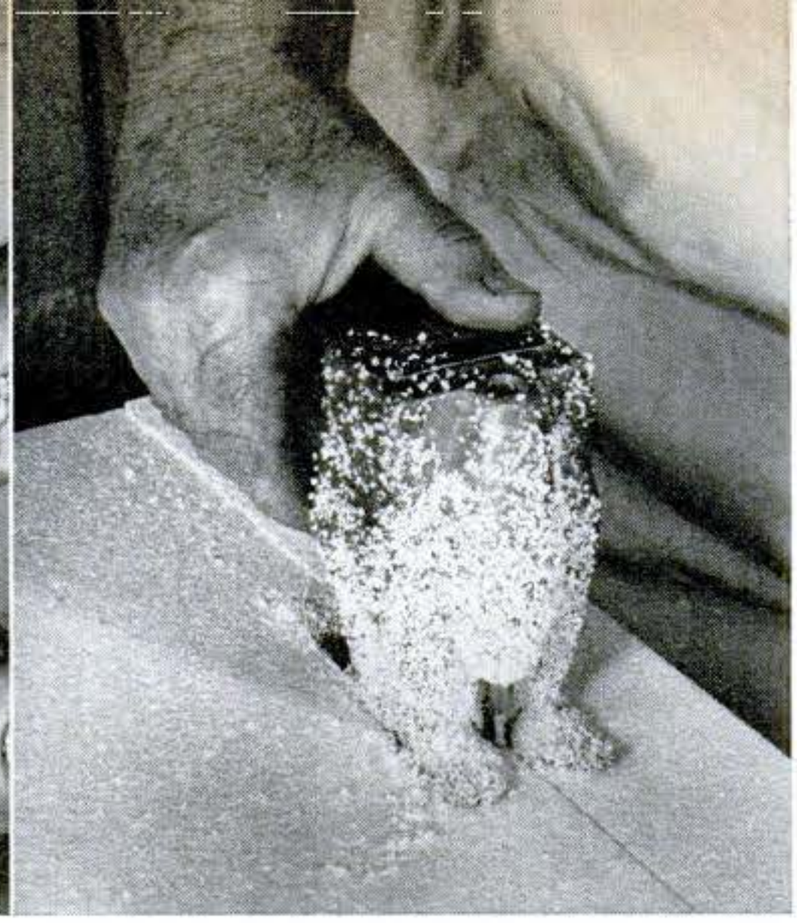
Stainless steel knife, heated with torch, is best foam-cutting tool. Wrap the handle with rags to insulate your hand. Cuts are as smooth as original surface.



Saber saw will do the job with fine-toothed blade, but be prepared for dust that clings to tools and clothing. You need whisk broom and vacuum.

under the window and the casing around it can usually be removed, then replaced after the foam and paneling or wallboard are in place. A wider stop strip inside the casing's inner edge completes the job.

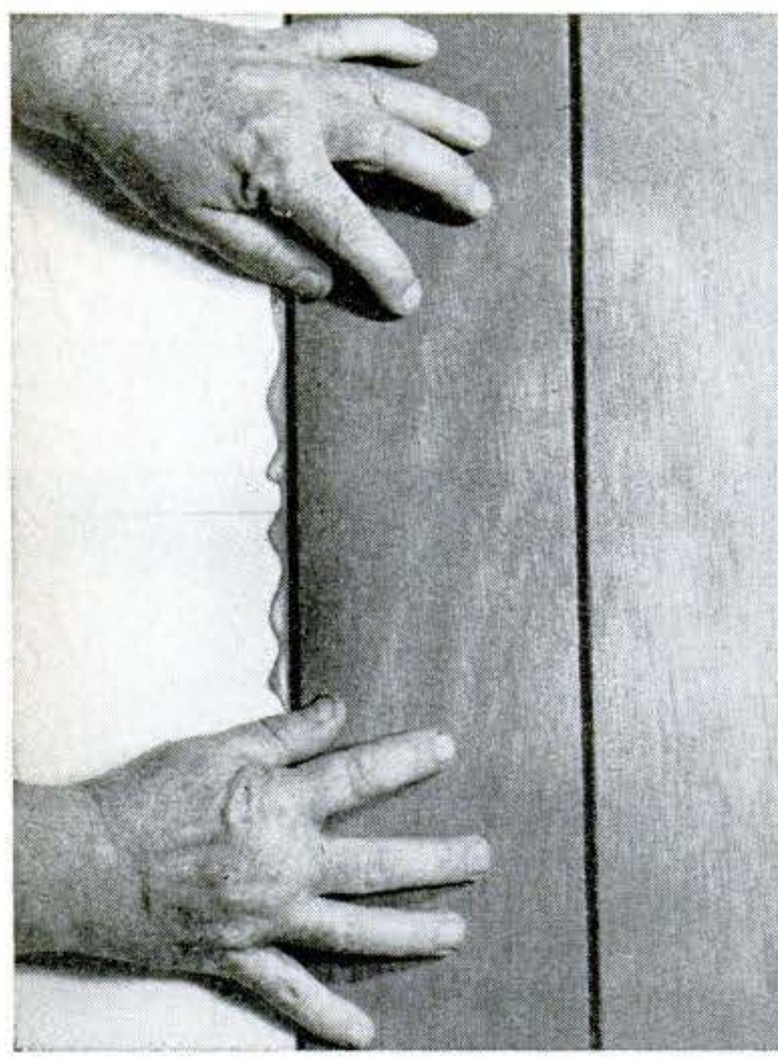
Baseboard and shoe mold should be removed before the foam is installed, then replaced over the paneling or wallboard. At electrical outlets, cut openings in the foam and paneling large enough to permit emergency removal of the cover plate.

For the ceiling, plan according to the job. On a plain ceiling you can stagger the foam panels like bricks. If ceiling is average height you can use 2"- or 3"-thick foam (your supplier will probably have to order it) to get maximum insulation. PS

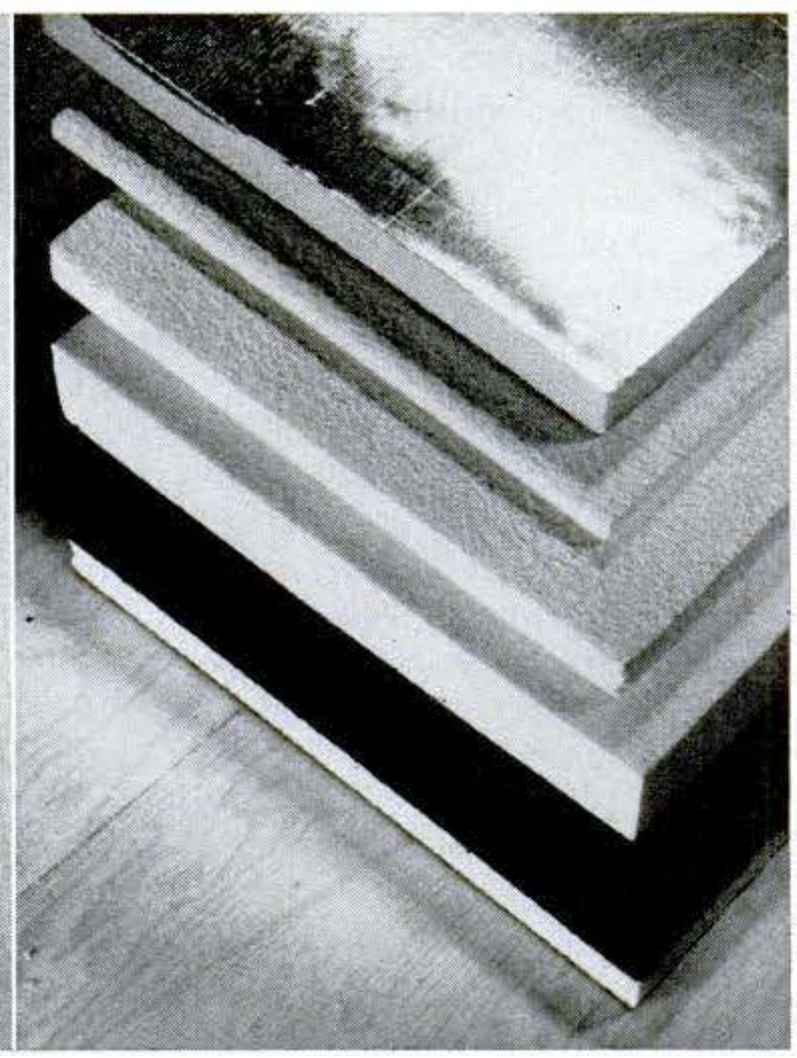
Apply mastic along edges and at corners with notched trowel. Mix mastic thoroughly or solvents on back surface of foam can cause hollows on the front.

Test-fit panels that go around windows and doors. Then stick them in place. Remove baseboards before foaming, replace them over finished paneling.

A quick tack bond between paneling and foam is possible with some mastics. Just push and pull panel in and out of position a few times, then press flat.



Press panels firmly into place. If mastic oozes out around edges, skim it off before applying next panel. This keeps the panel fronts clean as you go.



Foam insulation comes with and without reflective vapor barrier. Bottom piece is asphalt-felted on both sides for rooftop use. You then cover with roofing.

How much heat can double glazing save?

Since windows may account for as much as 40 percent of your home's exterior wall area, heat loss through glass is a major factor in fuel conservation. In existing homes, the best you can do is wrestle up well-fitted storm windows; but in new construction or remodeling, buy windows of insulating glass (double panes with an air space between) preferably mounted in wooden sashes.

Ponderosa Pine Woodwork has compiled statistics (based on sample homes across the snow belt) that indicate such windows in a fully insulated house* can save up to a third of the energy required for heating, compared to the same house with single-glass aluminum windows. In extreme cold belts (where "degree days" exceed 7500 during heating season) *triple* glazing is recommended—either conventional storm windows over the insulating glass, or special IG sash with removable storm panel.

*FHA standards: R-19 in ceilings, R-11 in walls. See "Is Your Insulation Up to Winter?" PS, Nov. '72.

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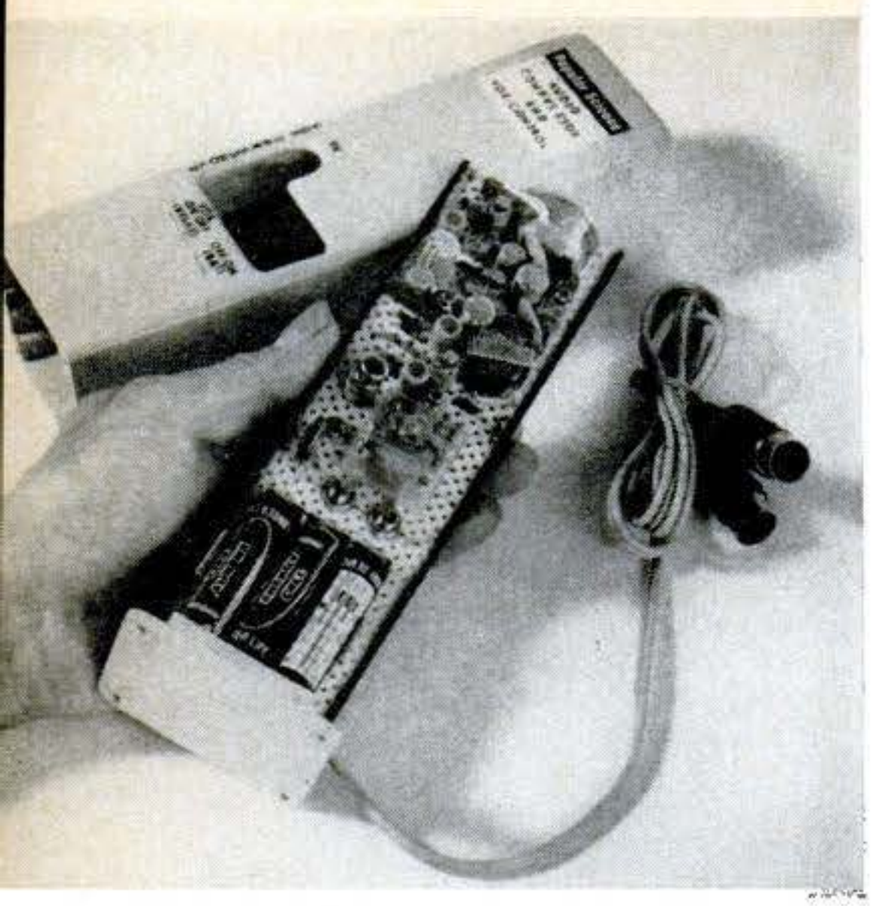


Audio compressor and VOX circuit plug into your tape recorder and substitute for standard microphone. Author's carved wood case allows hand-held operation or stand-alone operation.

Automatic Volume and Vox for Your Tape Recorder

This special microphone starts your recorder and sets level automatically

By GREG BEARD

If you've ever tried making recordings of conversations, you know that getting a good tape—from beginning to end—is a bit tricky.

Starting your recording too early means tape waste; starting it at just the right time is a gamble. Too often that first sentence is lost, if you're asleep at the switch.

The recording level nearly always needs a "touch up" during the taping; it seems to defy logic. And trying to record a speaker who's a "bobber and weaver" or someone moving about a room can be frustrating.

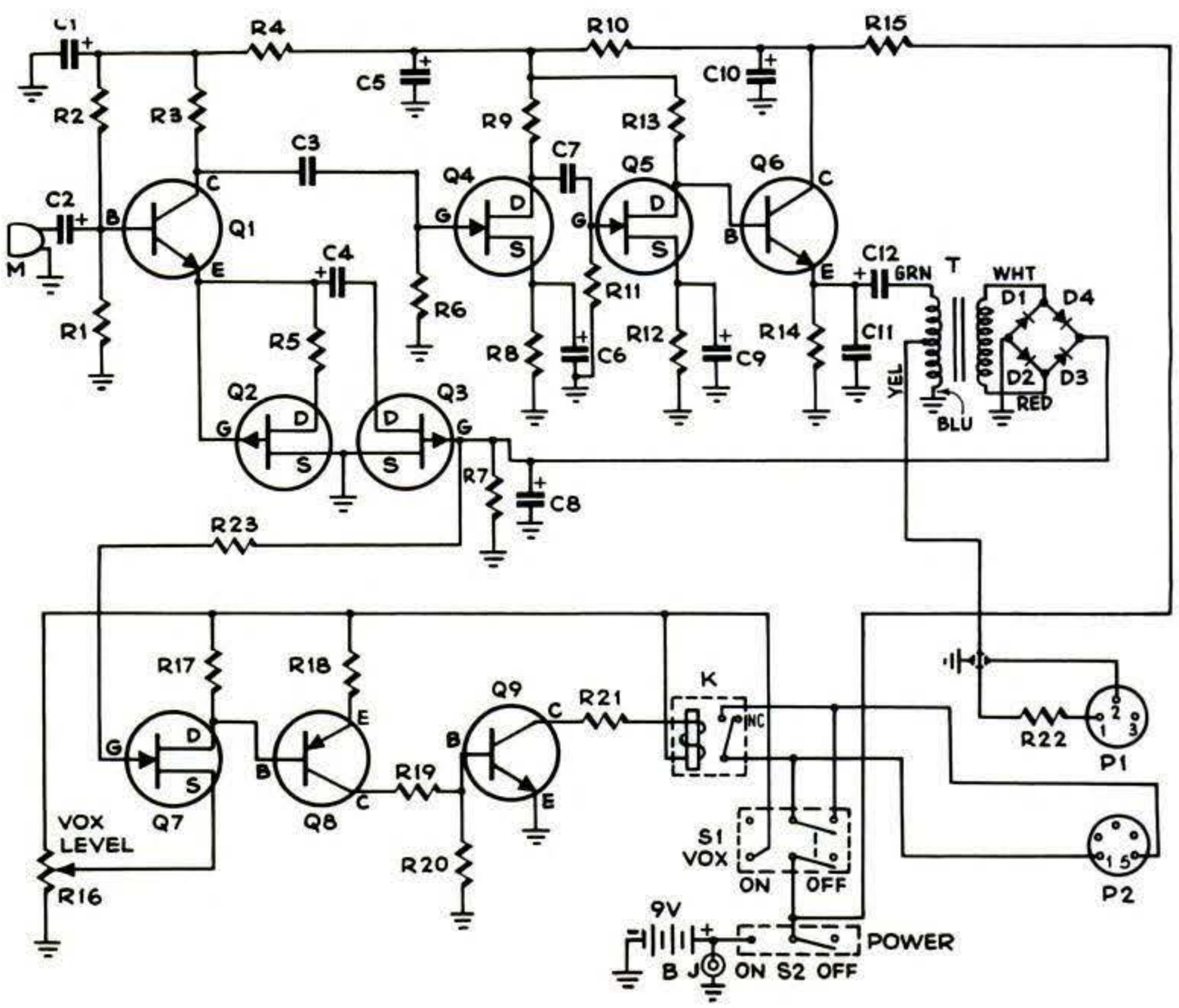
Recording with this special microphone, however, will add two significant extras to your tape recorder.

The first is a VOX (actually a voice-operated on/off switch). The VOX circuitry simply uses the microphone to measure the amount of sound that is normal for the area you are in. Anything above that level (preset by R16) indicates to the VOX that the speaker—or whatever you wish to record—has started, and so should the recorder.

Almost instantaneously, a relay clicks and the recording has begun. And, as a bonus, approximately two seconds after your subject has stopped (allowing for deep breaths) the VOX automatically stops the recording. No more wasted tape and no more missing sentences, either.

The second addition you'll have made to your recorder is a compressor, or automatic volume-control circuit. Once a recording level is set, the compressor circuit will keep it

Continued



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The "typical" American camper:

We can help him and her pack more comfort into camping.

SHOULDERS: Carry less driving burden. Adjust for comfort as you adjust the wheel.

MIND: It's easier keeping it on vacation fun when the driving's more comfortable. That's what Power Steering and Tilt-Wheel Steering are all about.

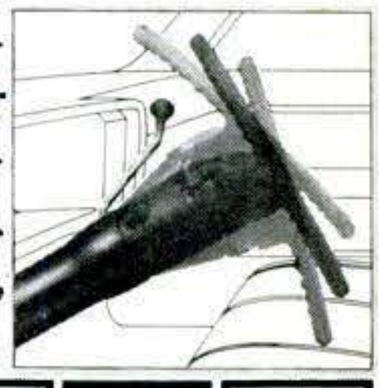
ARMS: Have less work to do, with Power Steering.

TUMMY: Tilt-Wheel Steering gives you plenty of room for it.

KNEES: Same thing for them.

FEET: Should be pointed in the direction of a GM dealer for a *demonstration.*

Power Steering and Tilt-Wheel Steering are two things you should take camping. Power Steering helps make handling easier, even on rough back roads. And parking easier, even in tight places. Tilt-Wheel lets you adjust the wheel to *your* most comfortable driving position while you drive. Also moves out of the way to make entry and exit easy. See your Chevrolet or GMC Truck dealer for a demonstration of Power Steering and Tilt-Wheel Steering.



Saginaw Steering Gear Division, General Motors Corporation.

SAGINAW
POWER STEERING
TILT-WHEEL STEERING

Saginaw GM

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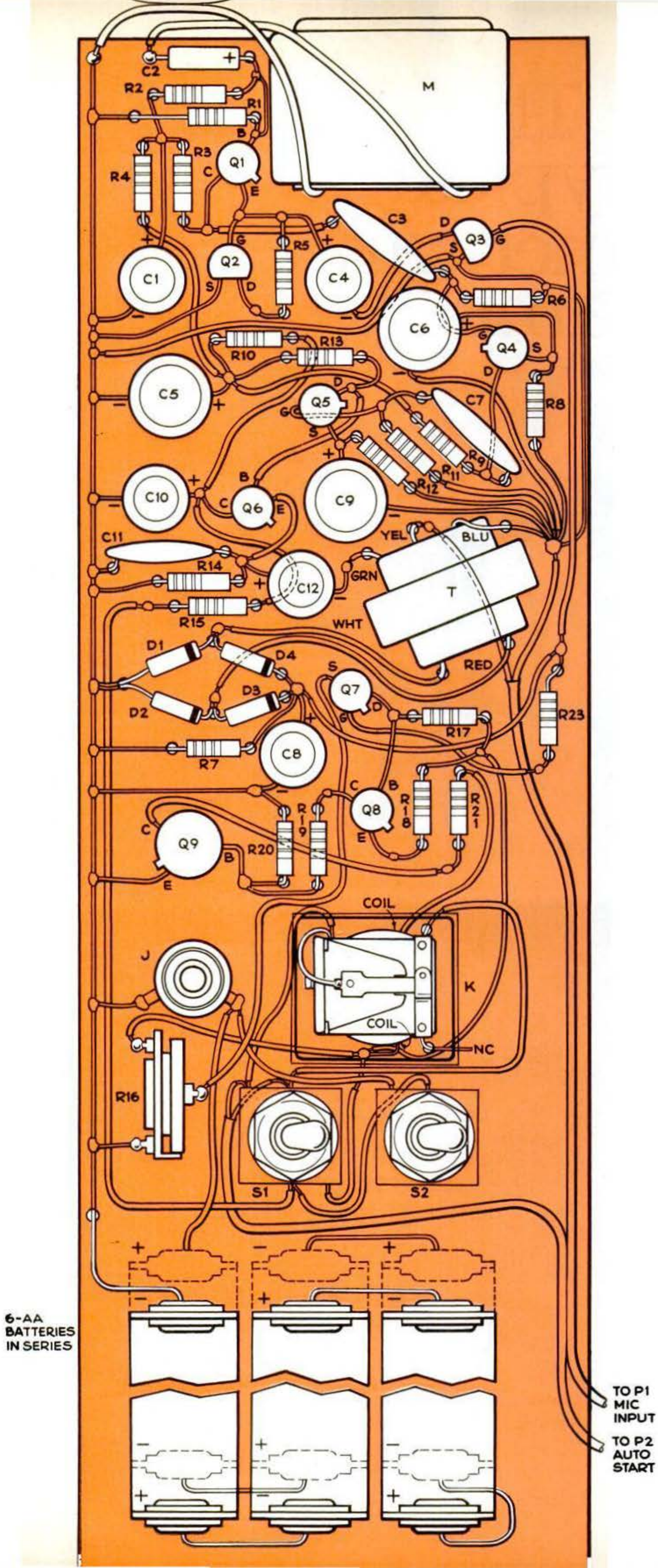

constant. When a "bobber and weaver" is close to the mike, the compressor automatically turns the recording volume down. When he weaves away, however, the circuit compensates by turning the gain up. You're no longer constantly plagued with watching VU meters.

Construction. All components for the VOX and compressor fit on a 2¼"-by-8" perforated board. Use #22 bus wire with sleeving for all component interconnections, and shielded wire to the connectors. The exact type of connector you use will depend on the jacks installed in your particular tape recorder. P1 should mate with the microphone input jack on your recorder. P2 plugs into a remote start/stop input. If your recorder does not have this, installing one is simple.

Just wire a two-pronged connector in series with the batteries of your tape recorder. With the recorder on, shorting the connector pins will start the recorder. Connected to P2, however, your machine will start each time K1, the relay in the VOX circuit, closes.

Six AA batteries, three on each side, are wired in series to get the required nine volts. If you wish to use another nine-volt source, however, you can simply plug it into jack J with the tip being positive.

Once the VOX/Compressor is connected to your recorder, turn on S1 and S2, and set the VOX threshold (R16) to just above room noise. Adjust the record level to nominal and make a few test recordings checking for distortion. Once you've found the right level for your recorder, you're set. Your next live recording will be right—automatically. PS

PARTS LIST

C1, 4, 8, 10, 12—50mfd electrolytic capacitor
C2—2.2mfd electrolytic capacitor
C3, 7, 11—0.1mfd ceramic capacitor
C5—220mfd electrolytic capacitor
C6, 9—100mfd electrolytic capacitor
R1—120,000-ohm, ¼w resistor
R2—56,000-ohm, ¼w resistor
R3, 9, 13—10,000-ohm, ¼w resistor
R4, 10, 14—1000-ohm, ¼w resistor
R5—15,000-ohm, ¼w resistor
R6, 11—1 megohm, ¼w resistor
R7—120,000-ohm, ¼w resistor
R8, 12—2700-ohm, ¼w resistor
R15—56-ohm, ¼w resistor
R16—50,000-ohm, miniature potentiometer
R17—6800-ohm, ¼w resistor
R18—1500-ohm, ¼w resistor
R19—150-ohm, ¼w resistor
R20—2200-ohm, ¼w resistor
R21—330-ohm, ¼w resistor
R22, 23—560,000-ohm, ¼w resistor
D1, 2, 3, 4—diodes 1N266 or equiv.
Q1-Q6—NPN transistor Motorola HEP 50
Q2, 3—P-channel FET 2N3820
Q4, 5, 7—N-channel FET Motorola HEP 801
Q8—PNP transistor Motorola HEP 52
Q9—NPN transistor Motorola HEP 53
T—output transformer 1K-200K Radio Shack 273-1376
K—miniature relay Radio Shack 275-004
S1, 2—DPDT mini toggle switches
P1, 2—see text
M—dynamic microphone Philips ELO91/10 or equiv.
J—minature phone jack
All electrolytics 16 volts

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In the last three years, over a quarter million people switched from other makes of cars to our Satellite. That was only the beginning.

This year, we're out to win you over.

Announcing the 1974 Plymouth Satellite Wagon.

For three years now, our Plymouth Satellite Wagons have had more cargo room than any other mid-size wagons in the country. And for three years, people have been switching from other cars and wagons to Plymouth Satellite.

This year, we expect our '74 Satellite Wagon to win you over.

Maybe it'll be the fact that our wagon is big enough to carry 4'x 8' paneling on the rear floor even with the tailgate closed. (Compare that to other mid-size wagons.)

Maybe it'll be the three-way tailgate itself, which makes it easy to load either things or people.

Or maybe it'll be the way we engineered this wagon. With a torsion-bar front suspension. A body made strong by more than 4,000 welds and quieted by more than 95 individual components to reduce noise.

Maybe it'll be the Electronic Ignition System with no points or condenser to replace. It virtually eliminates ignition tune-ups. And helps spark plugs last as much as 18,000 miles.

Or maybe we'll win you over with the fact that all our engines run on regular gas.

You see, getting a quarter of a million people to switch from other cars and wagons to our Plymouth Satellite in the last three years was only the beginning.

Whatever it takes . . . this year we're out to win you over.

Watch AFC Football, Championship Baseball Playoffs and the World Series on NBC-TV. Brought to you by Chrysler Corporation.

Mid-size Plymouth Satellite.
Extra care in engineering...it makes a difference.

CHRYSLER
Plymouth

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PS LEISURE HOME Plan of the Month

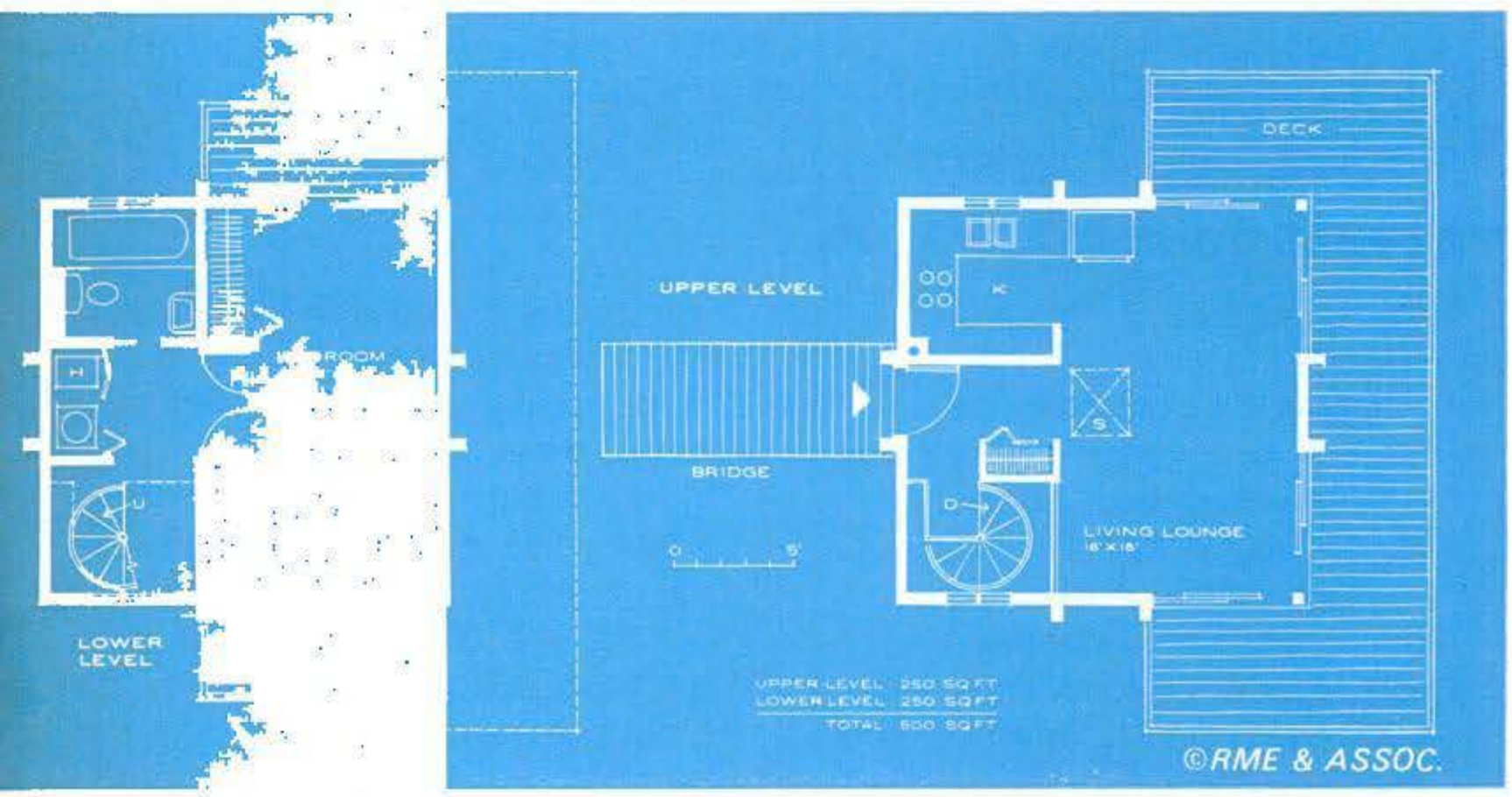
STILT HOUSE Can Stack Two Ways

If your site is less steep, reverse levels: Tuck entry floor under bedrooms

This two-story, two-bedroom house is a cozy size, despite its imposing appearance. It's a veritable eagle's nest, perched on eight sturdy columns in close-set pairs, and tied to its hillside site with a dramatic catwalk. As illustrated here, the house has the living room on its upper (entry) level, connected to the lower bedrooms with a spiral staircase. But the plan is easily reversed for a more conventional stacking.

Either way, each bedroom retains its private balcony and easy access to the bath and utility rooms. A compact kitchen is handy to the open-plan living–dining room on the other floor, flooded with light from the sliding patio doors on three sides that open the entire space to a cantilevered deck. The roof has a wide overhang to shelter outdoor activities; it pagoda-peaks to a central skylight.

Unlike the other nine homes in our series (which continues through December), this one—the Olympic—is an adaptation from an earlier group. We asked architect Robert Martin Engelbrecht to refine his earlier design without sacrificing any of the original impact. Any way you stack it, this is one of his most versatile homes, adaptable to many sites with minimal excavation. It's ideal for a couple with one or two small children . . . as a "shared" investment for two childless couples . . . or—eventually—as a retirement retreat with guest room.—*Al Lees*



Architect's plans: several ways to order

A study plan for the Olympic—floor plans with additional specs to help you decide if house fits your needs and site—is only $1. V-PAC Guide ($2) catalogs other plans in our series, also shows homes from previous series, and includes building tips from V-PAC Council members (15 leading manufacturers and agencies in leisure-home field). One set of Olympic blueprints, $25; three sets $35 (if you need extras to file for approvals). Address all orders to PS Vacation Plans Service, Box 622, Princeton, N.J. 08540.

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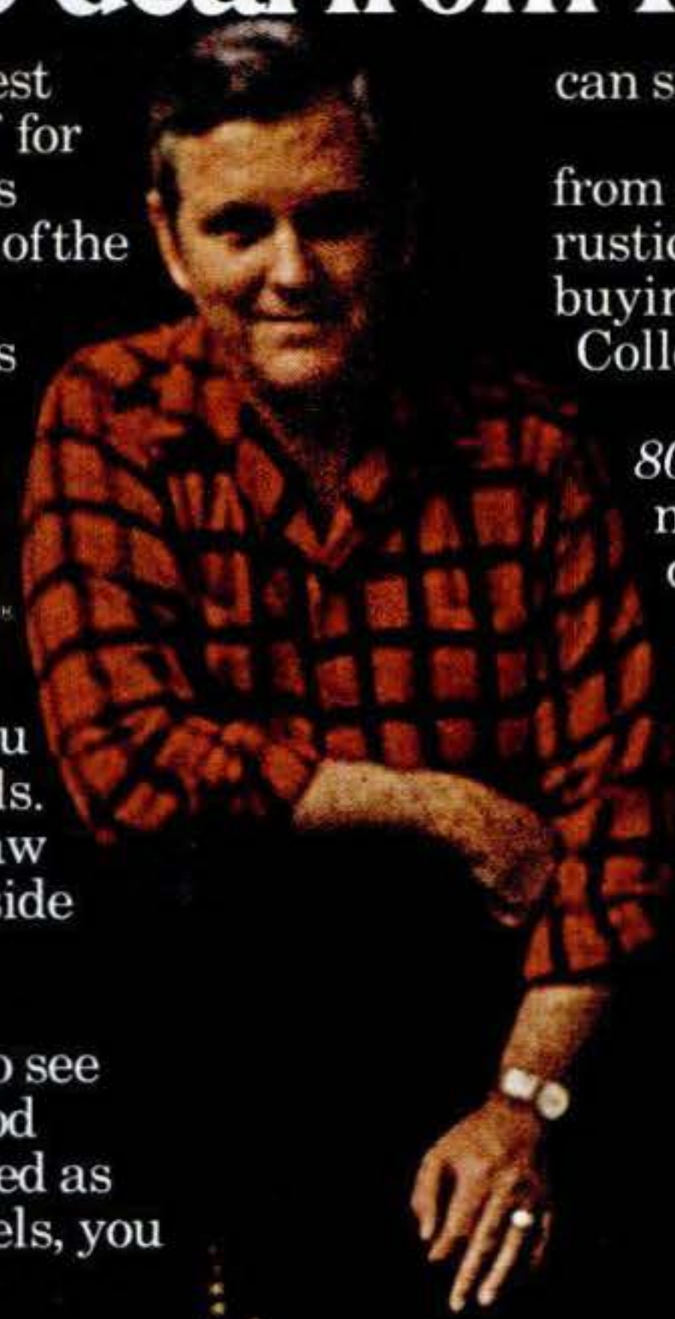
"Buy 12 Craftsman panels, get this jig saw free. That's some deal from The Paneling People."



"One of the best deals I've ever heard of for home handymen." That's what Wally Bruner, host of the do-it-yourself TV show "Wally's Workshop", says about this special offer.

Here's how it works: U.S. Plywood, The Paneling People, will give you a Rockwell® Model 67 USP Jig Saw absolutely free, when you buy 12 Craftsman® Panels. This double-insulated saw lets you cut panels face-side up and it sells in stores for $19.99.

So it's easy to see you're getting a very good deal. And even if you need as few as 6 Craftsman panels, you can still get the saw for only $6.

There are ten different looks to choose from in our Craftsman line, ranging from formal to rustic. Or you can also get the same free saw by buying 12 panels from our new Weldwood® Collection.

Call toll-free 800-447-4700 (in Illinois, 800-322-4400) to find out the name of your nearest participating lumber or building supply dealer. And hurry, offer ends December 31, 1973. (Or such earlier date as supply is exhausted.)

From the company that makes fine U.S. Plywood products, to the dealer in your neighborhood who carries them, you'll get a good deal from

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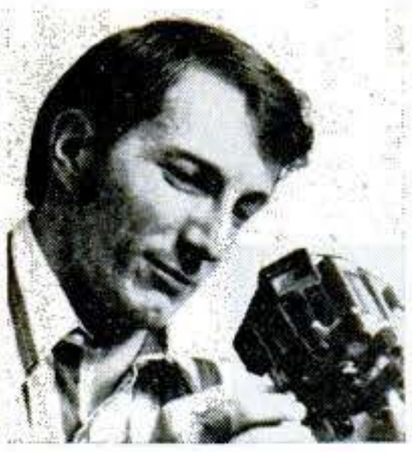
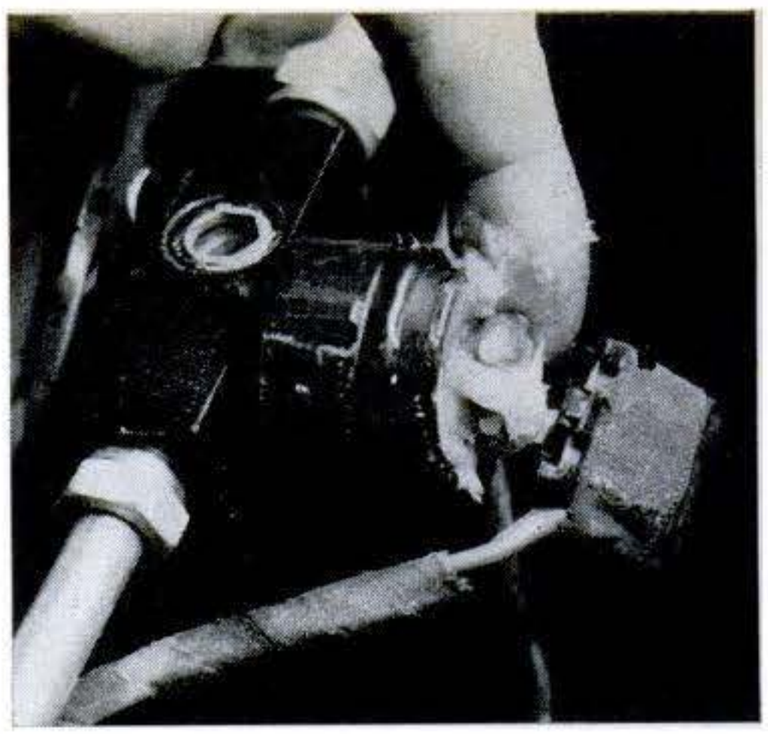


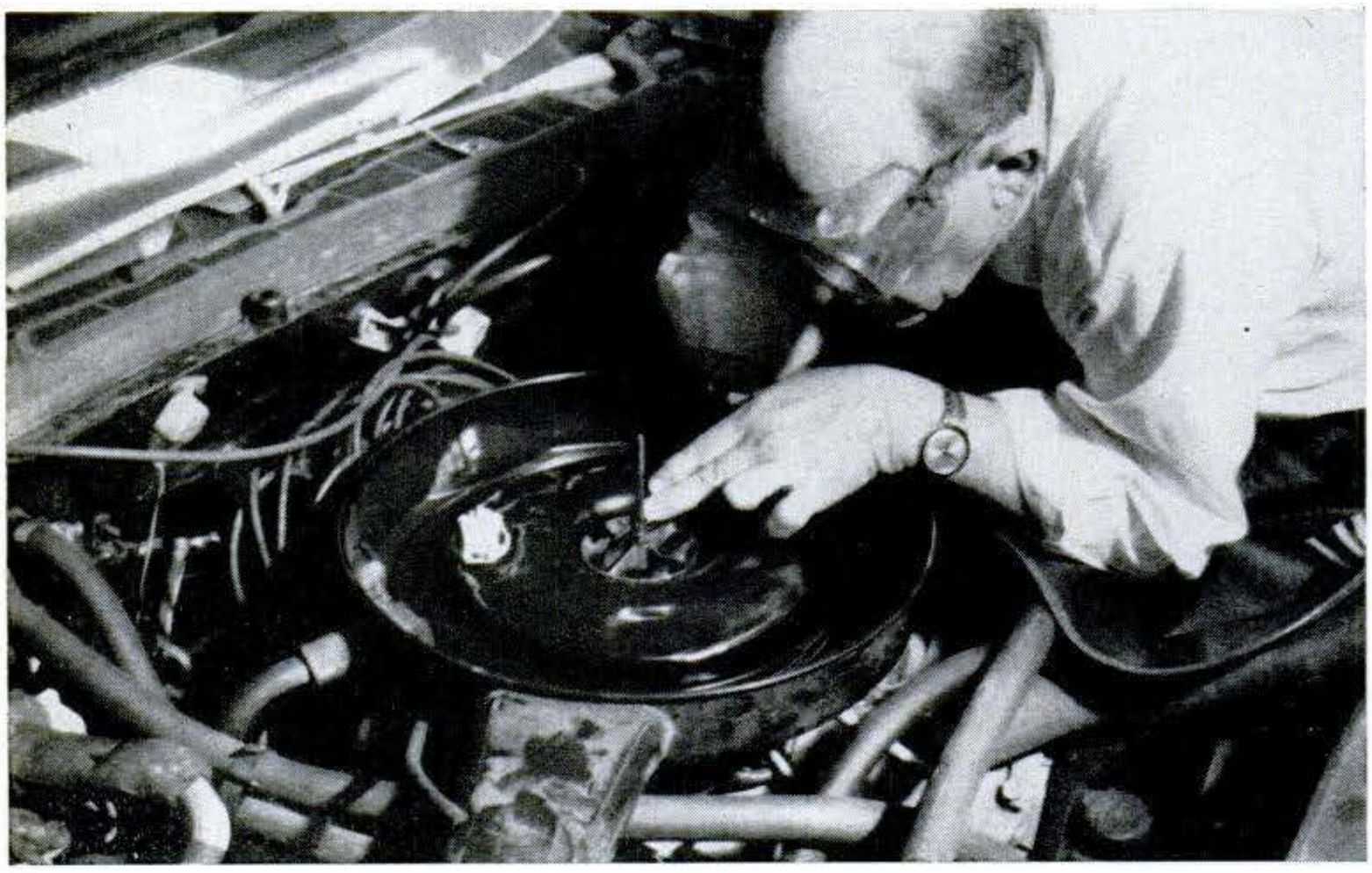
Taking Care of Your Car

By RAY HILL

Good hints others have used

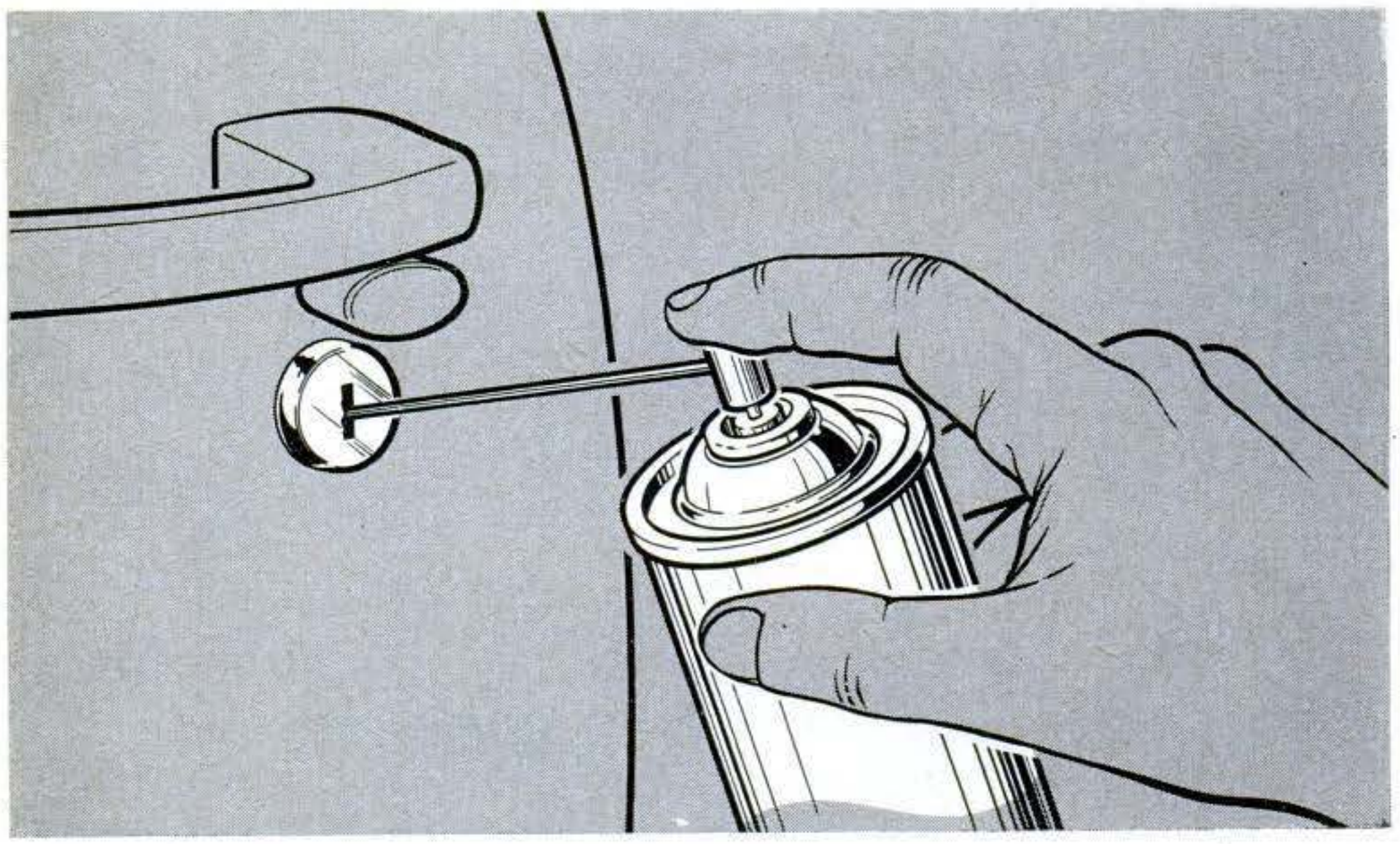
If you have a helpful car tip, send it to Car Care, Popular Science, 355 Lexington Ave., New York, N.Y. 10017. We'll pay you $25 for each one we use. Photos aren't necessary. Sorry, but no tips can be returned.





Stumble and lag on acceleration

If this is your car's problem, it may be caused by an accelerator pump plunger cup that is worn. You can quickly tell if this is the case by checking the discharge from the discharge jets of the accelerator pump. Remove the air-cleaner cover, open up the choke with your finger, and look down into the carburetor. If, when the accelerator pedal is depressed, gas doesn't shoot out of the jets in a steady stream, the plunger cup is worn.

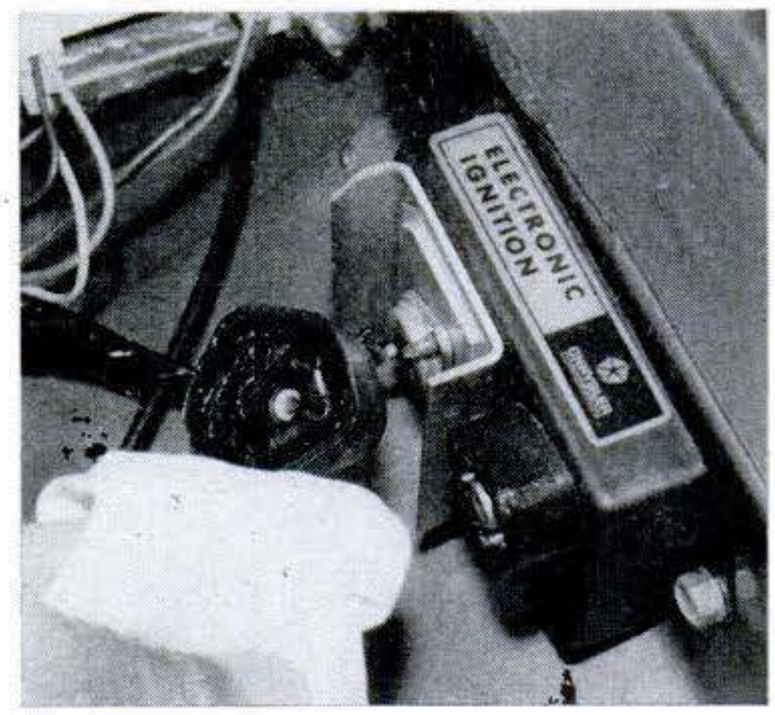


When it's difficult to remove door and trunk keys

Insufficient lubrication often causes this problem, but there's an easy cure. Buy a can of Dow Corning 4X Spray or an equivalent silicone spray. Use the nozzle extension furnished with the aerosol can to inject the lubricant into the cylinder. After you've sprayed the problem lock, insert and withdraw the key several times to disperse the lubricant evenly within the cylinder. You should have no further trouble removing the key.

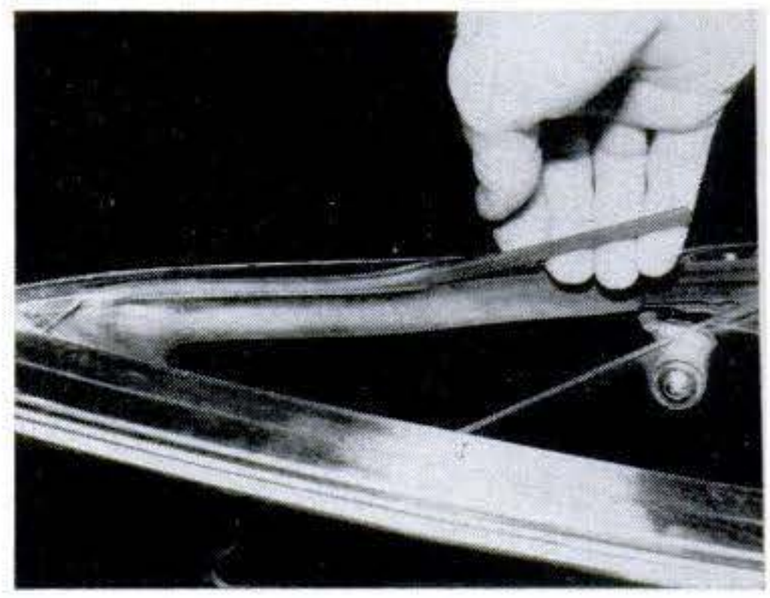
Switch-terminal corrosion?

To stop corrosion of the terminals of your AC's low-pressure cut-out switch, remove the electrical connector from the switch. Then, clean the switch cavity, and use grease to fill the cavity and coat the terminals. Reconnect the switch and you've kayoed corrosion.



Electronic-ignition control

Some control units that check out on a tester won't work on a car because of a heavy grease coating applied to the wiring-harness electrical terminals by the vendor. Removing this excessive grease coating may allow the electronic control unit to operate as it should.



Wind noise and water leakage

Wind and water leaking in at the upper-front section of a vent window? The gap between weather strip and glass may be excessive. Add a rubber spacer (about 1/8" by 3/16") between weather-strip flap and door frame to improve sealing. Make sure the glass is firmly bonded.

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New cars need a different kind of oil. And with what a new car costs, you can't risk buying the wrong oil.

Not every kind of oil is right for new cars. Some oils can do more harm than good simply because they lose their ability to lubricate your car's engine. How does this happen? New car engines run hotter because they have to run with so many more things making demands on them.

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Together they put more heat on your oil. So when it cools it can sometimes turn into a thick, coagulated mess.

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[Continued from page 118]

ticed the fuselage flexing or "springboarding" much the way you may have seen the wingtips of a 747 or 707 bending up and down as they pass through air bumps or clouds.

Defer, who has made over 100 flights in the Concorde, told me "the workload flying the Concorde is less than flying conventional sweep-wing jets. There are no spoilers or speed brakes to worry about. We are very steady, with stability augmentation systems on all three axes that take care of keeping the plane smooth at all times. We even have automatic controls that can make completely automatic landings in Category IIIA 'zero-zero' visibility."

I almost said, "Just like a Piper Cub, alors," when Defer came up with another interesting bit of information.

"To trim our ship at different speeds we shift fuel back and forth."

When speed increases on the SST, the aerodynamic center of pressure moves rearward, and as a result the plane needs retrimming. On a conventional plane this can be done with a trim tab that makes an aerodynamic change in the shape of the elevator. But this adds drag and a speed penalty. On the Concorde the same effect is accomplished by transferring fuel from a group of forward tanks to a fuel tank in the rear. Then, after supersonic cruise is over, and the plane slows down, fuel is transferred forward to put the center of gravity where it's needed for best subsonic control.

Like other supersonic craft, the Concorde varies its engine air intake and exhaust openings to match speed requirements. During takeoff the intakes, which have movable ramps and intake flaps at the bottom of the engine, are wide open to permit maximum air flow. Once over Mach 1.3, the ramps start to close automatically to control the position of the shock wave and reduce the volume of air coming into the engine.

"What happens if an engine suddenly shuts down during supersonic flight?" I asked. This has actually happened; the plane simply reduced speed and landed without incident on three engines. Had it been on a transatlantic flight it could have completed the trip on the three.

To demonstrate how well the automatic systems function, one of the routine demonstrations when airline pilots are aboard is to shut down two engines on one side while the Concorde is flying at Mach 2. The autopilot takes over, and there is less than three degrees' yaw during the operation, which is promptly corrected.

Up front I noticed that talking to air-traffic control seemed to take more time and energy than actually flying the plane. Jean Franchi thinks something will have to be done about reducing the number of traffic reporting points. The Concorde covers ground faster and "we climb faster, too," Franchi says. "Anytime we are given a clearance to climb, air controllers will have to realize we can be there fast. We won't have to go great distances to reach our altitude. We can be there in the next three or four minutes."

You can't see it when you're sitting back inside the passenger cabin, but both the nose and an aerodynamic visor drop down out of sight during takeoff and landing.

For landing, the nose is down completely out of sight with excellent forward visibility. But some pilots would like to have something visible out there in front as a point of reference. In the earlier test planes, Franchi said, there were TV cameras in the cockpit facing the ground since the pilot sits 38 ft. ahead of the nose wheel. "Doing a taxi turn the first time on a 150-ft. standard runway, the pilot finds himself way out over the grass, to his surprise, while the nose wheels are still on the runway. But we don't even turn TV on anymore, and 02 does not have it," Franchi adds.

I was up in the cockpit when the shield and nose were lowered for landing. There's a distinct increase in aerodynamic noise in the cockpit.

Descent speed above 10,000 ft. is about 325 knots and below 10,000 ft. is limited to 250 knots for all jet aircraft. Approach speed is 152–156 knots, touchdown 135–145.

Actual touchdown was so smooth I just barely felt the wheels on the

Continued

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ground. But even before landing there's something different about the approach in this delta-wing plane. The descent is made with an angle of attack of between 13 and 14 degrees, and the fuselage has an attitude of 11 degrees. Franchi told me, "The floor never pitches down and passengers never have the impression of going down."

After flying in the Concorde, I hopped down to the Aerospatiale production plant at Toulouse, south of Paris. This was my third trip to the plant in the past six years. The first time, I had climbed around the prototype. This time I got a look at parts of the 16 Concordes in actual production; odd-numbered planes are being assembled in France and even-numbered in England. Present price per plane (including spare parts) is about $45 million. A Boeing 747 is close to $28 million.

Who's buying? U.S. airlines have canceled their options for the plane, which was a serious blow. As of this writing, there are firm orders for nine from BOAC and Air France, plus provisional orders and options for six more from Air Iran and the People's Republic of China.

In Russia the Tupolev Tu-144 is in full production, and the planes have been seen by French and American aviation experts. Four test models have been flown, including the one that crashed at the Paris Air Show. According to Robert Hotz, editor of *Aviation Week and Space Technology*, who saw them, Aeroflot, the Soviet airline, has 30 on order now and eventually expects to have as many as 75. In addition, a bigger improved 180–200-passenger SST with a new variable bypass engine is being developed. It is designed to be more economical, less noisy, and have greater range.

Not many people realize how far along the Concorde program has come. The first two prototypes (001, 002) flew more than four years ago.

More room. Two preproduction models, 01 and 02, which have design improvements and are slightly roomier than the prototypes, have been flying since early this year. A fifth model for fatigue testing is being assembled. The first two production models, 1 and 2, are scheduled to fly this fall. Seating can range from 108 to 128 passengers.

Both the Concorde and the Tu-144 have had some interesting changes since I last saw them two years ago. The Concorde has a new nose and visor for improved forward vision, and the fuselage has been lengthened to 204 ft. The Olympus 593 two-spool turbojets have an improved annular combustion chamber that practically eliminates the trail of smoke the prototypes used to leave behind. New TRA (thrust reverser aft) engine-exhaust nozzles give more thrust, reduce noise, and save weight.

The production Tu-144 has 140 seats, three plus two abreast in tourist, and two plus one in first class. Thrust of the Kuzneyetsov NK-144 turbofans has been upped to 44,000 lbs. each from the original 40,000 lbs., and normal cruise is reported as Mach 2.2 to 2.3. This is faster than the previous prototype and the Concorde. The Russians have announced that the new plane could easily fly the 3500-mile Paris–New York route with 140 passengers at an average speed of 1080 mph, which would make the trip less than three hours. On a westbound trip this means arriving almost three hours (local time) before you took off.

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Sonic boom. How about the sonic boom? [See PS, Oct. '72] Plans for going supersonic on the Concorde are restricted to over open water or sparsely settled land areas.

The Russians claim that the problem of sonic boom has been greatly exaggerated. They believe the overpressures from Mach 2 at 60,000-ft. cruise altitude will be well within acceptable noise limits. They foresee no restrictions on overland flights within the USSR.

The crash of the Soviet Tu-144 at the Paris Air Show and its possible effects cannot be ignored. Some expert witnesses think that somehow during the flight demonstration the Russian pilot pulled the nose up too high and stalled at low altitude. Then he nosed down with full power to get control speed, but there was insufficient height to make the recovery gradual. He apparently tried to pull up and turn abruptly at the same time, overstressing the plane and causing the right wing to fail.

Concorde officials told me they were not concerned about the same thing happening to their plane. What did bother them was that possible delay in the Soviet SST, which is planned for service in 1975, might prompt the Russians to deny permission for another SST to start service across Siberia to the Far East.

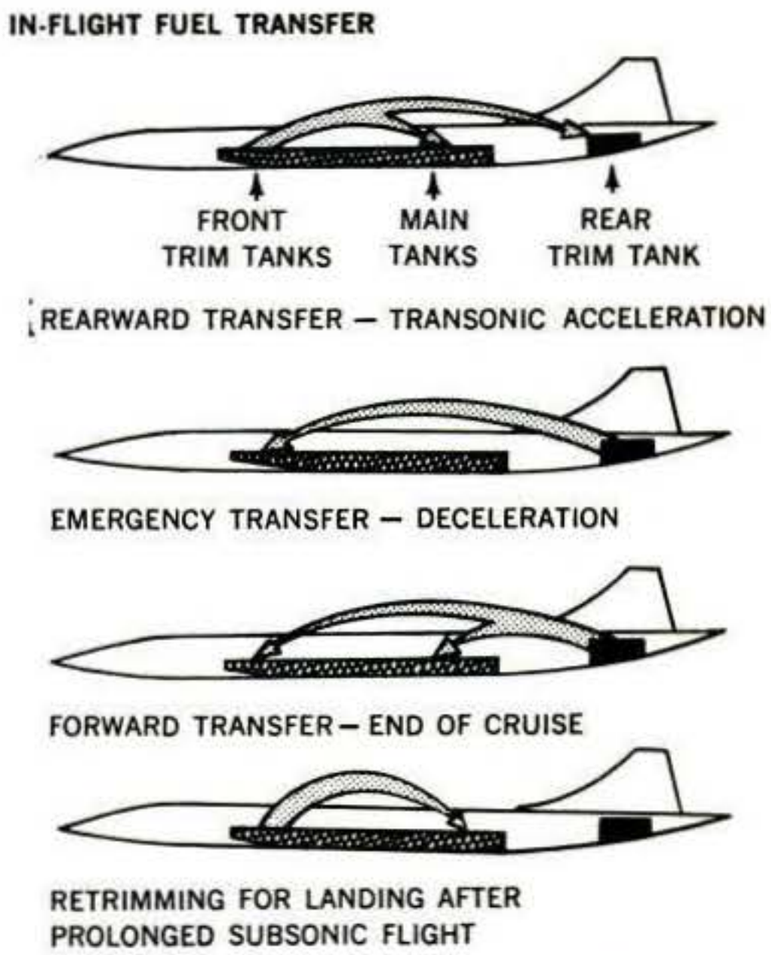
Critics of the Concorde argue that the plane will not be able to make transatlantic flights economically. As may be expected, the British and French argue this point with economic projections that show the supersonic will attract most of the first-class passengers now flying the subsonic jets and operate at a break-even load factor of 37.5 percent. Fares would be about 10 percent plus or minus present first-class fares, with travel time cut in half, they say.

The new head of our FAA, Alexander Butterfield, has said that certification of the Concorde for commercial operation in the U.S. is about 85 percent complete. He anticipates operation in the U.S. by early 1975 by Air France and BOAC.

A couple of days after my SST flight, I was on my way back across the Atlantic, and making the flight in a Pan Am 747. I sat there contemplating the fact that I could be making the trip in 3½ hours instead of 6½.

The 747 was smooth, the food and drink fine. But suddenly it seemed pedestrian and slow. I had acquired a taste for supersonic travel.

I predict you will, too. PS



Aerodynamic center of the SST moves in subsonic and supersonic phases of flight. To compensate for this shift without extra drag of external trim controls, fuel is shifted back and forth from rear trim tank below tail of plane.

and pussycats

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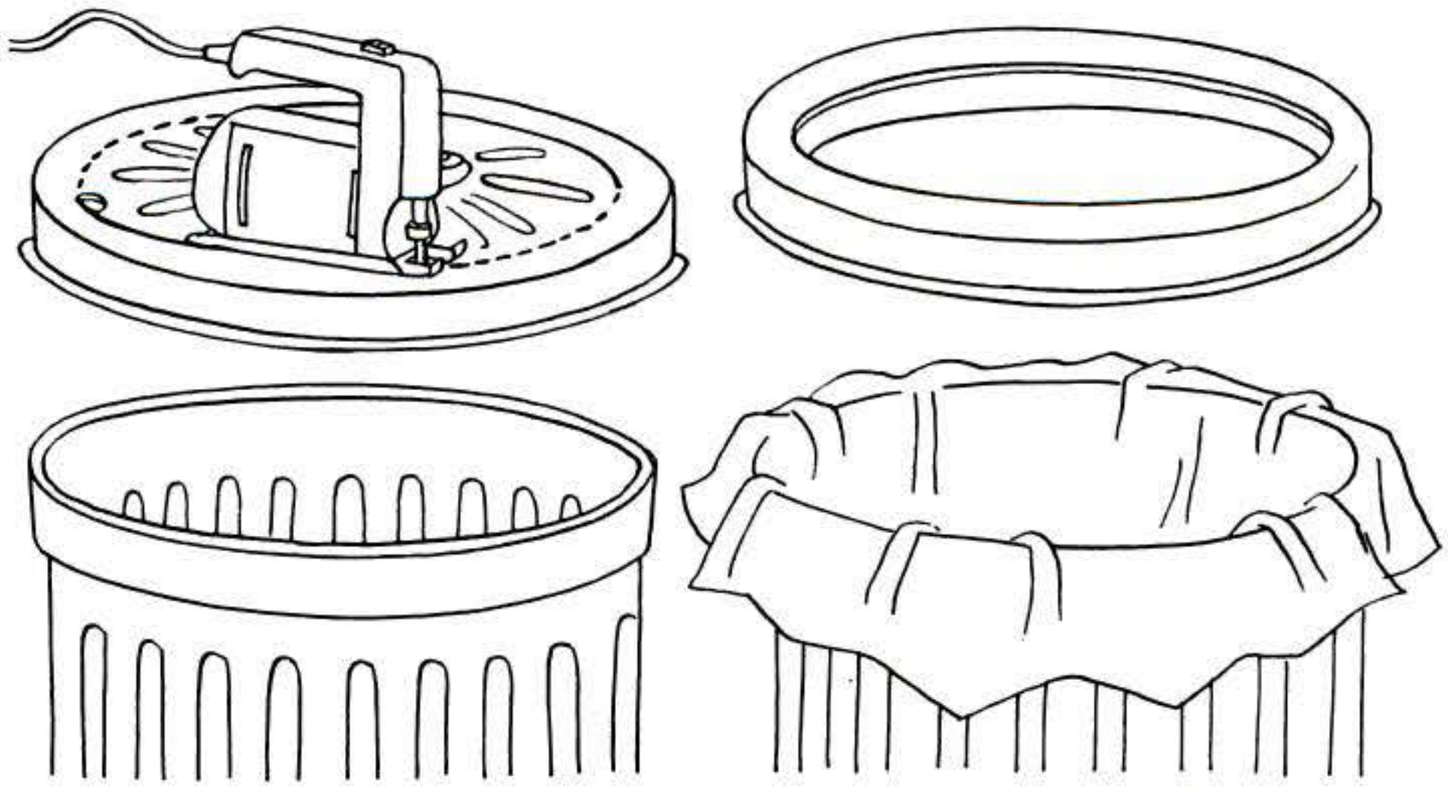

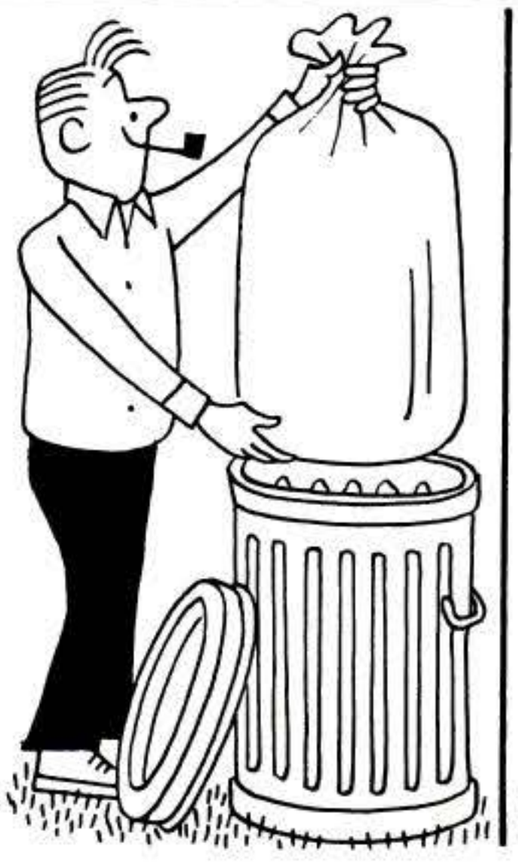

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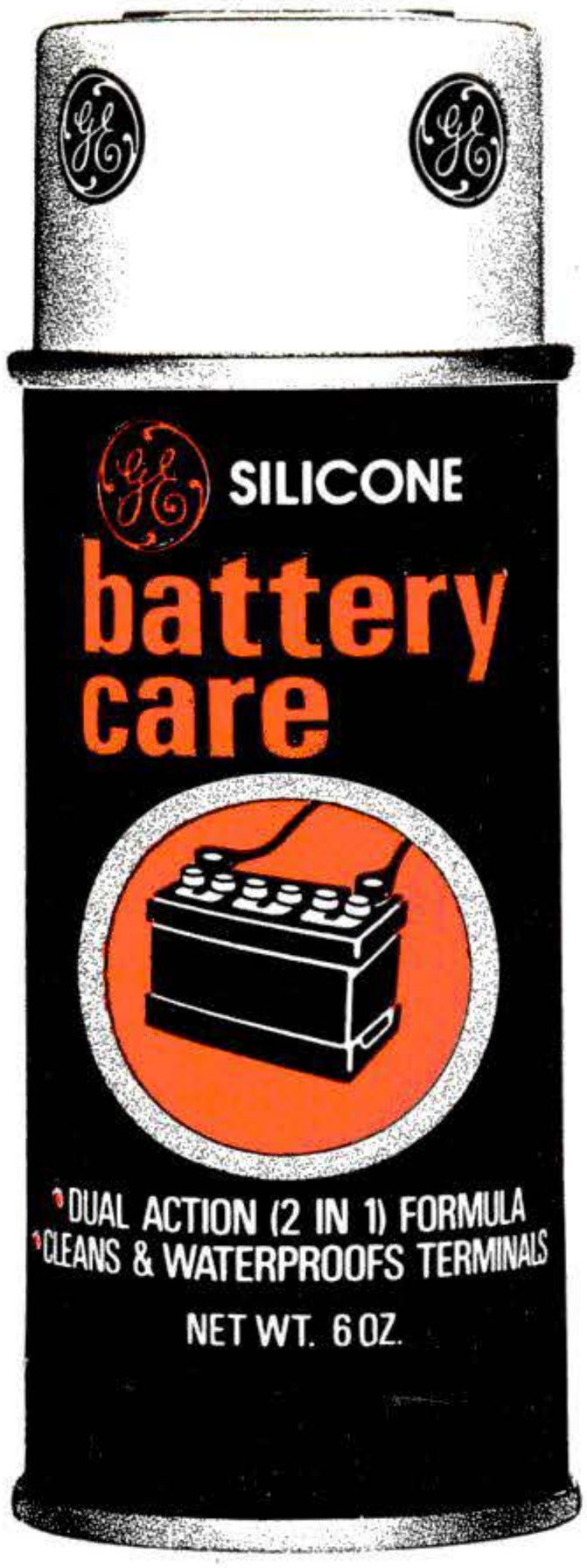

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GENERAL ELECTRIC

Superbatteries

[Continued from page 103]

—from a glovebox heater, I noticed crystals forming almost instantly in the beaker. Argonne's fused salt is clear, like water.

In Argonne's conceptual cell for off-peak energy storage (drawing), the fused salt would permeate the porous stainless-steel negative electrodes containing lithium, the porous-carbon positive electrode holding sulfur, and the ceramic-cloth separator between the electrodes.

During discharge, lithium is oxidized at the negative electrode, forming lithium ions and releasing electrons. The ions migrate to the sulfur electrode, combining with electrons from the external circuit to form lithium sulfide. Charging the cell reverses the process.

Compact module. The 11-pound, disk-shaped cell would produce 1850 watt-hours during discharge. Seven hundred such cells, stacked in a 5-by-5-by-28 array, would fit a compact cube five feet on each side. Output of the battery module would be enormous: 1.3 megawatt-hours at a 12-hour rate.

Modules could be placed in huge office/apartment buildings as well as urban utility substations, explained Martin Kyle of Argonne's battery program. Such buildings—Chicago's Hancock, for example—have moderate 24-hour load variations (60 megawatts peak, 40 megawatts minimum) because they have apartment dwellers.

One-hundred modules (100 megawatt hours) installed in a basement corner would help level the utility's load by storing energy, and reduce the number of electrical lines into the building. "Your lines would only have to feed, say, 52 megawatts," Kyle said. "Otherwise your line would have to be sized for the peak (60 megawatts)."

Electronically regulated motor generators, converting AC to DC for charging, or DC to AC for power distribution, would be used with the modules. Batteries would be connected to provide about 440 volts, Kyle estimated.

Vehicle batteries. Complementing Argonne's research on superbatteries for off-peak energy storage is an NSF-sponsored program to develop lithium-sulfur batteries for electric vehicles. Although research data is interchangeable, significant differences exist in requirements.

"A car battery is tougher because power requirements for automobiles are very high," says Kyle. "When you press down on the accelerator you want that car to jump." Argonne's goal is for lithium-sulfur vehicle batteries with a power density of at least 90 watts per pound. Off-peak storage batteries—delivering their power slowly and steadily—would require only 23 watts per pound. Specific energy for both batteries: about 100 watt-hours per pound.

These performance figures for vehicle batteries are necessary to provide acceleration and range equivalent to gas-powered cars. Cruising range with lithium-sulfur batteries might be 250 miles, with a maximum speed of 75 mph.

Other battery differences: Whereas a three- to five-year life for vehicle batteries might be adequate, peak-leveling batteries must last five to 10 years or more. Electric-vehicle batteries would discharge in one to four hours, off-peak-storage batteries in 10 to 14 hours.

Commuting car. Kyle also points out that a lower-performance car may develop from battery research. A national survey has indicated that 50 percent of the people owning two cars in urban areas would be willing to accept a lesser-performance car (than their gas-powered vehicle) for commuting and running about. That alone will be a market of 10 million cars, Kyle suggests.

If you parked your car during the day, how would you keep the battery electrolyte hot? "We estimate that it would take more than 40 hours to freeze," Kyle said. After heat dissipated from the thick thermal insulation, you would have to plug in the battery heater. Battery energy might also be used to slow solidification of the electrolyte.

GM and Ford have conducted internally funded research on high-temperature cells for many years. Ford is researching a sodium-sulfur battery that uses a solid ceramic—beta alumina—as an electrolyte, operating at about 580 degrees F.

Great Britain, with the most advanced high-temperature battery program outside the U.S., has already operated a van using sodium-sulfur, solid-electrolyte batteries. Sodium, at 20 cents a pound, has obvious cost advantages as a battery element.

Researchers stress that much work remains to perfect reliable, long-lived, and economically feasible batteries. Each battery system has development problems unique to it, and cells that show promise in the lab may require years of engineering development before we can expect practical superbatteries to begin relieving the energy crunch. PS

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What type of project? We want ingenious, functional items, built of nationally available materials—wood, plastic, metal. For a hard-to-find item, list a mail-order source. Readers should be able to duplicate your project in an average home shop, using hand or portable power tools.

Merely decorative items will not qualify, nor will overly familiar projects such as bookends, birdhouses, or utilizations of discarded materials (bleach bottles, tin cans, etc.).

Only accepted material will be acknowledged; none can be returned unless accompanied by a self-addressed, stamped envelope. In case of similar entries, the one bearing the earliest postmark will qualify. Projects that don't qualify for this competition may be purchased at our regular rates for other use in the magazine.

The winning project for the fifth month will be presented in our February issue. To qualify, entries must be postmarked no later than October 26. Send yours to: Weekend Project Editor, Popular Science, 355 Lexington Ave., New York, N.Y. 10017.

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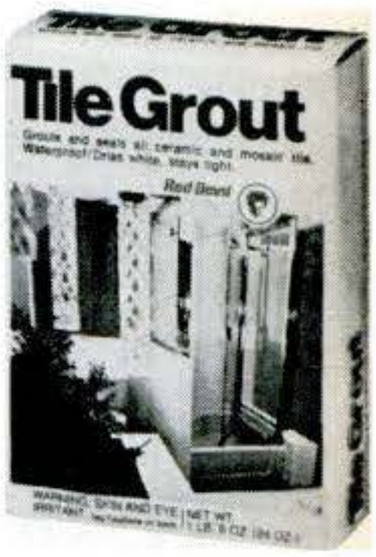

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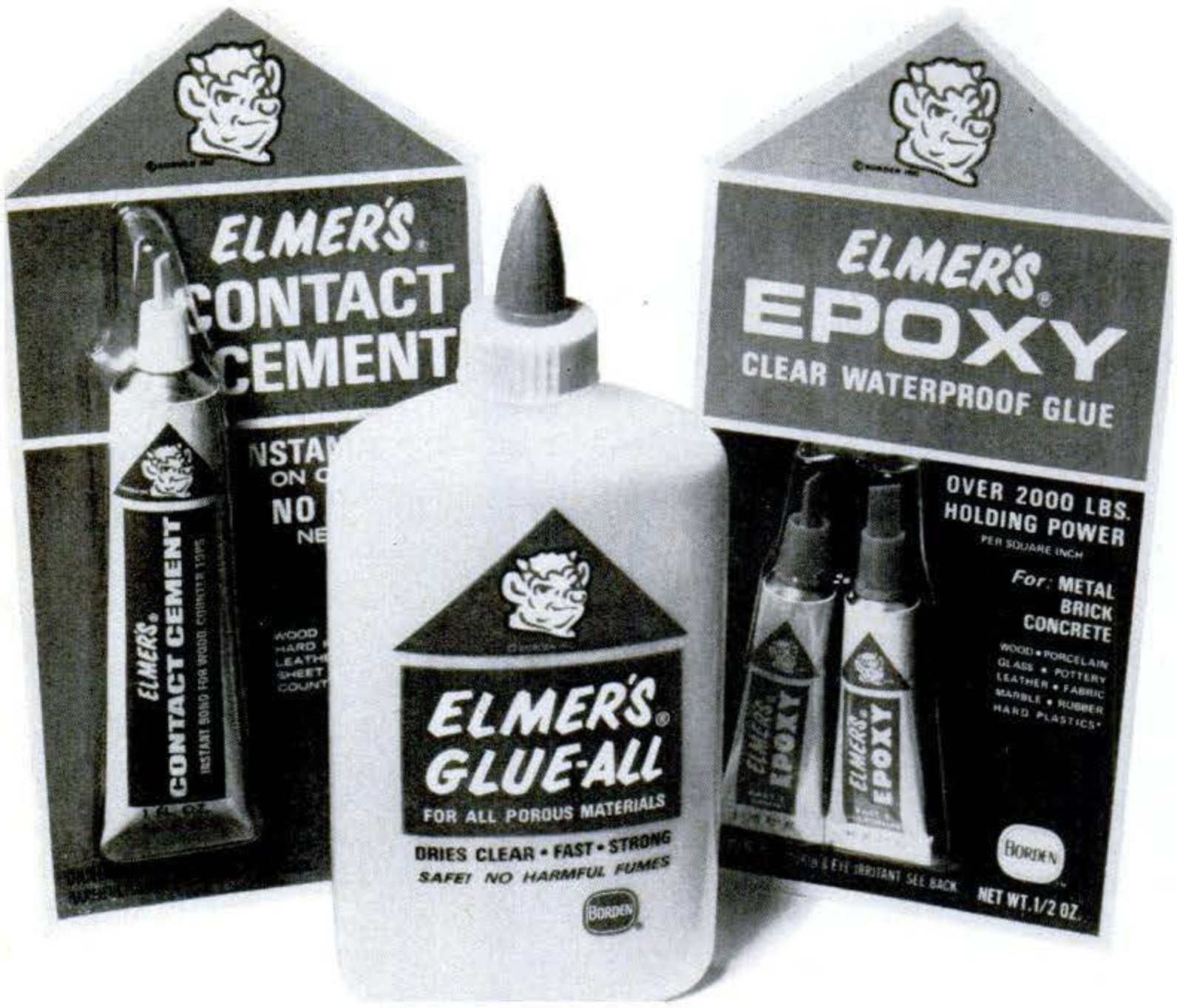

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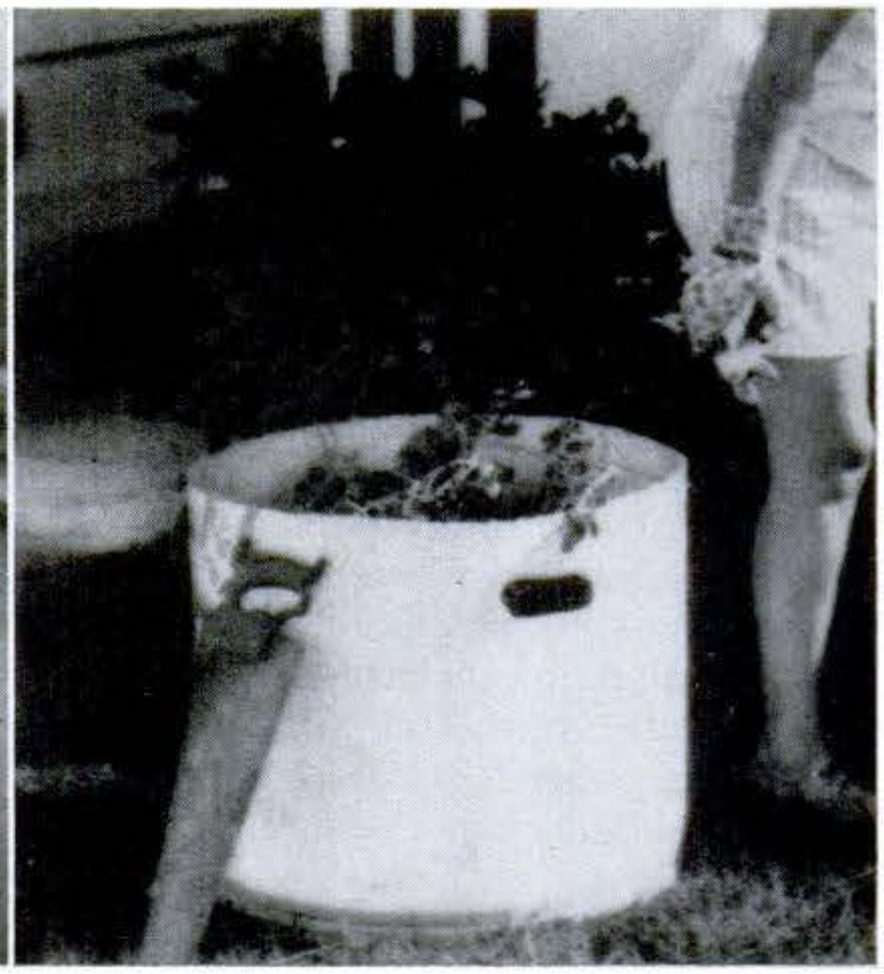
Fiber Drum Tables Do Double Duty

Handholds for using drum as waste barrel are cut with a jigsaw once drum has been halved.



Here's a fast, easy, and cheap way to recycle those big fiber drums manufacturing plants usually discard. And, you get something that's doubly useful: a waste barrel for grass clippings, weeds, or leaves that disguises itself as a table for your patio or rec room.

If you have trouble locating a source for such drums in your area, a suitable alternative is Sonotube—a concrete form available at building-supply stores. A couple of three-foot sections will make two tables.

Once you've got your drum, the procedure is simple: First cut it in half, using a handsaw. Then, with a jigsaw, cut two holes opposite each other and about three inches from the open end. These serve as handholds for the waste-barrel mode.

To convert to a table, you need a circle of ½-inch plywood with a diameter about a foot more than the drum's. Cut a cleat the length of the inside diameter of the drum; center and attach it to the underside of the plywood top. This holds the top in place, yet permits easy removal.

A wooden stand keeps the table high and dry for outdoor use. Two 1-by-6s, cross-notched at the center to form an X, have tapered ends for a friction fit in the open end of the drum.

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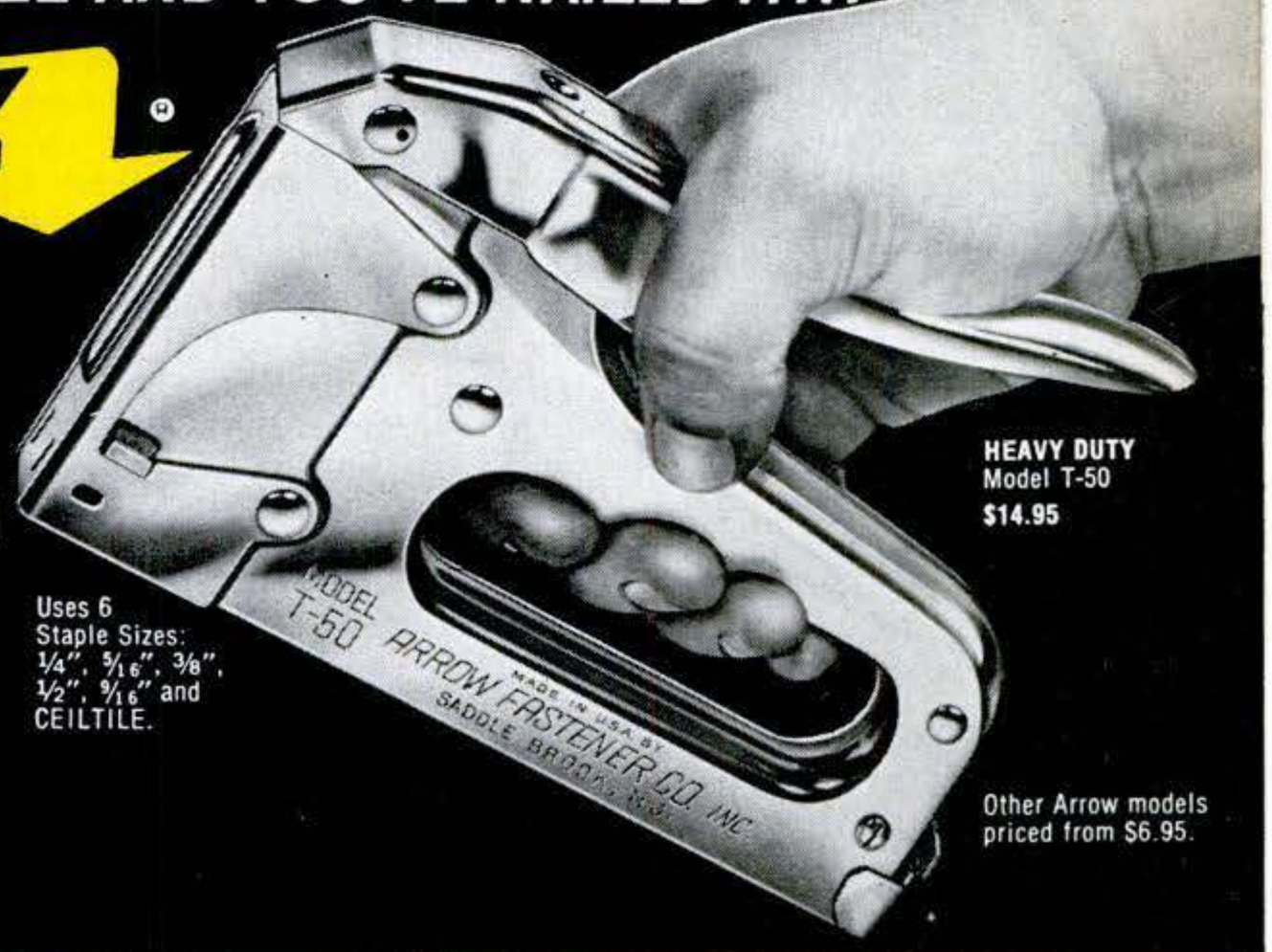

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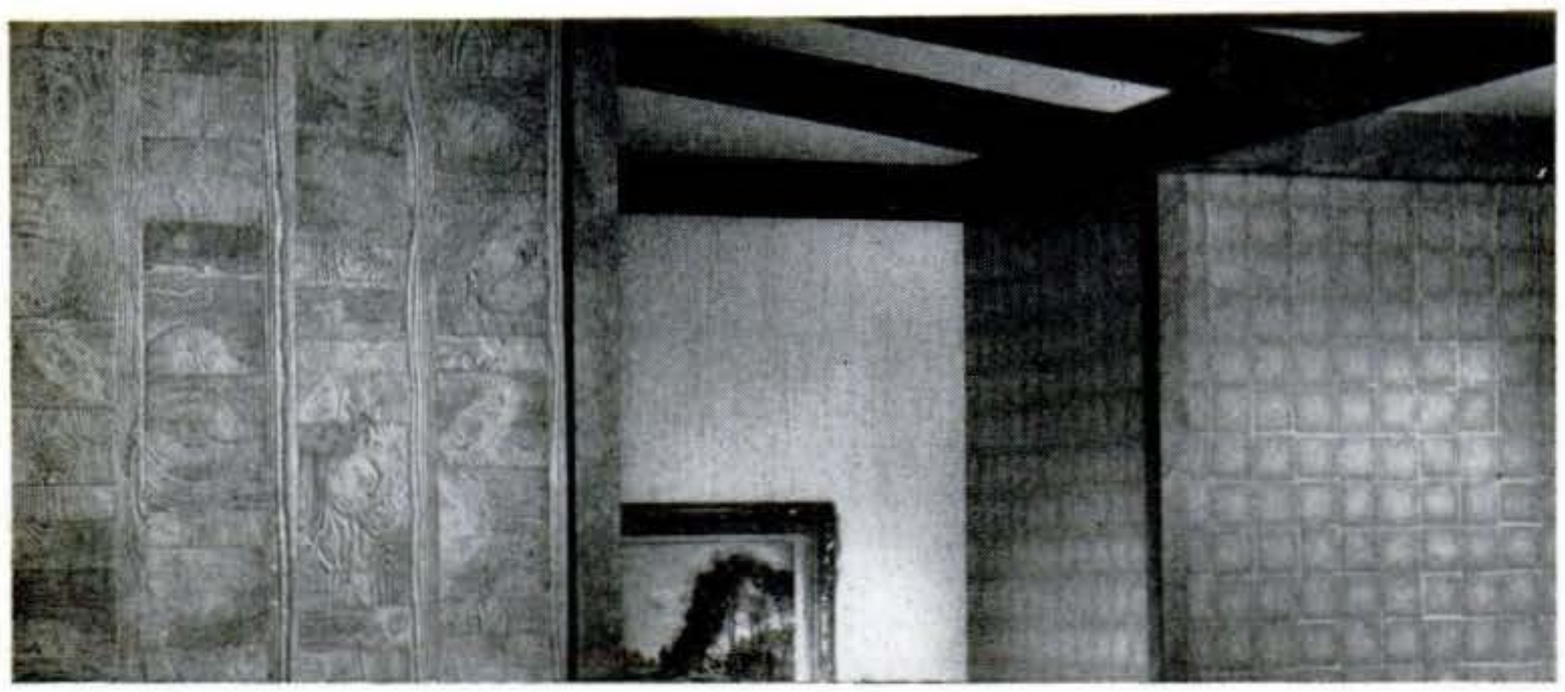
Shop Talk

News and views of tools and materials
By AL LEES

When is a copy better than the original?

Just got back from a press showing of room settings featuring six new patterns of Masonite prefinished paneling. The company was pushing four of them that constitute a new line they call their Historic Collection. But, handsome as these reproductions of traditional wood paneling are, I was most struck with two new additions to their Naturel Series, introduced peripherally to the "main event." Shown below, they're Millblock, a deeply dimensioned effect of end-grain blocks (left), and Mexicotta, a glazed replica of primitive terra-cotta squares (far right).

They set me to thinking about the vast improvement, over the last five years, in prefinished panel patterns. Prior to that, the industry was locked into a contest for flat-out woodgrain authenticity, and good as these photographic reproductions ultimately became, they remain shrewd simulations whose *raison d'etre* is economy. Sure, they're easier to put up and maintain than actual wood paneling (we can attest there's no faster wall surface to apply than prefinished hardboard, using gun adhesive). But the *main* reason for ersatz wood panels is: They're cheaper. So we welcome the latest trend, pioneered by Masonite's Naturel paneling (their new pair joins two cork, two brick, and four stone textures; for a free color brochure, write Masonite, Box B, Chicago 60690). Such imaginative designs offer wall possibilities that literally can't be duplicated with "real" material. In most cases, the effect is unique—not a slavish copy. And equivalent walls of actual materials simply wouldn't be practical—where would you *find* millblock, random cork, Mexican peasant tile, travertine slabs? Today, there's no limit to the variety of wall treatments you can have throughout your home.



For that $200: Good design

Response to our first two monthly design competitions has been heavy—and the trend is up. We chose our first winner [p. 119] from over 250 entries; have already considered 370 for next month's. But many projects submitted just don't qualify under our rules, reprinted in this issue. Before you enter, reread—and remember: The accent is on good design.

Speaking of which, we've just seen a valuable directory of workshops, studios, and craft museums nationwide that tells you where to see and buy quality crafts or supplies. *American Crafts Guide,* 192 8"-by-8" pages; $3.95 from Gousha, Box 6227, San Jose, Calif. 95150.

Debug for winter

You're not alone in wanting to snug up indoors during cold weather—so do ants, spiders, roaches, and millipedes. They'll soon be taking up seasonal residence, unless you let them know they're not welcome. Best way? Fall spraying of your foundation with a solution of chlordane, says the H. D. Hudson Co.—which just happens to make exactly the compressed-air sprayer for the job (above). Adjust the nozzle for a coarse spray and saturate at least 4" of the wall, plus the adjoining soil border.

Culled from corporate news

If you've ever had a new portable tool die in your hands the instant your 30-day warranty expired, take heart. Rockwell has extended *its* consumer warranty to a full year. Any double-insulated tool that fails within that time can be returned to place of purchase for replacement. Advances in tool design have upped quality to make this unique offer possible—without raising prices . . . Sidelight on this issue's MORE HEAT/LESS FUEL section: Borg-Warner engineers have computed that you conserve both fuel and water when you take a shower instead of a bath. Showers average three gallons a minute for seven minutes. That's 21 gallons, compared with 30 to fill a tub. PS

things to write for

- Questions about controlled humidity in your home—of vital importance this critical heating season—are answered concisely in a free booklet "Facts About Humidification," from Research Products Corp., Madison, Wis. 53701, makers of Aprilaire units.

- Two plans for redwood projects are offered by Louisiana-Pacific Corp., 1300 S. W. Fifth Ave., Portland, Ore. 97201. A graph-squared sheet of house numbers with details on how large to scale them and how to give them a rustic hand-carved look is 10 cents. A fine booklet of more than a dozen wine-rack designs—from simple to elaborate (plus tips on bulk storage)—is 50 cents.

- "How to care for your fine wood furniture" is a booklet of tips on removing mars, blemishes and stains from wax finishes. Though a pitch for Hagerty Vernax, it's generally useful; 25 cents, W. J. Hagerty, 3801 W. Linden, So. Bend, Ind.

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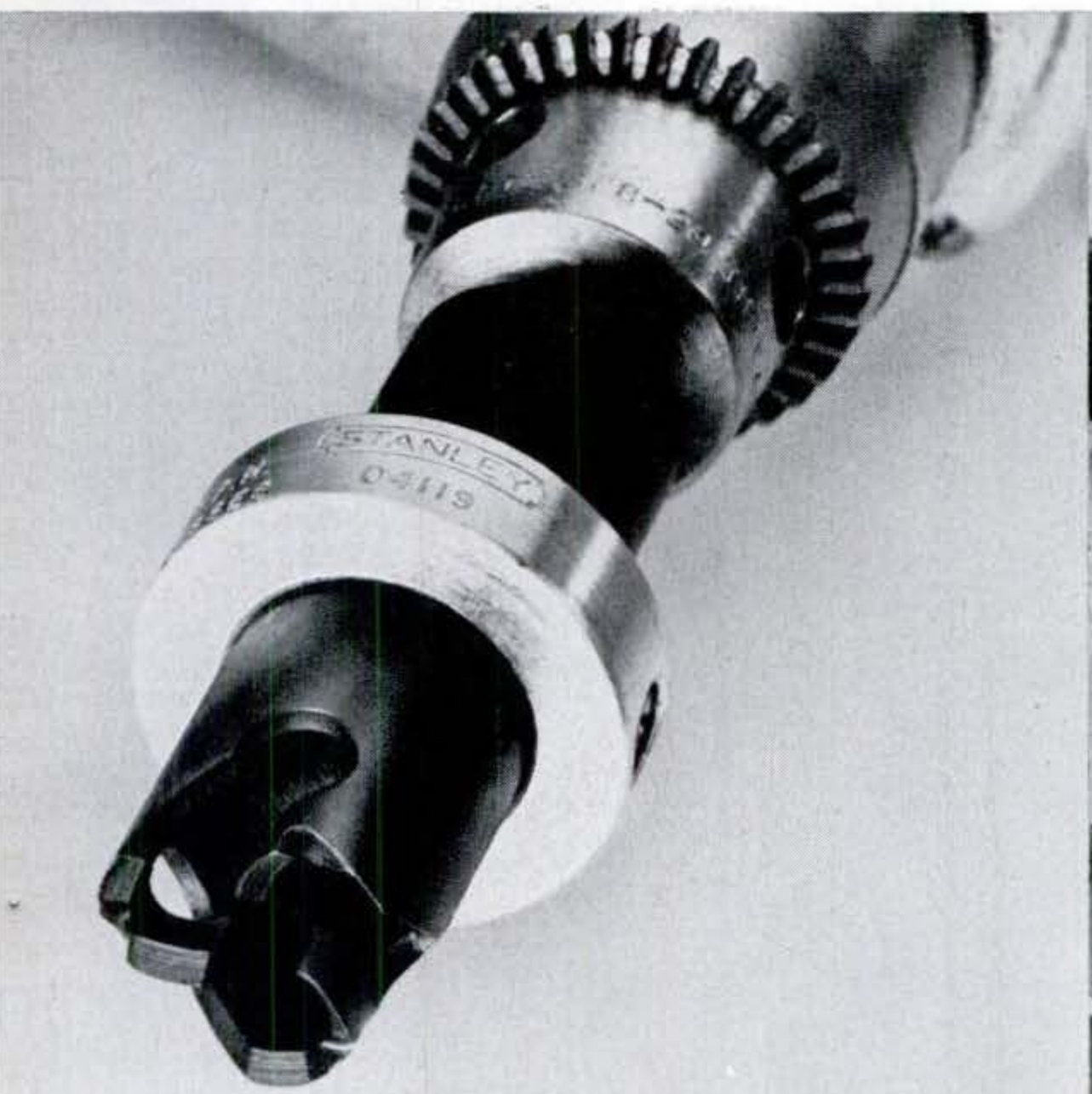

Stanley's remarkable new Electrichisel™ tool works with any electric drill. Makes dado, rabbet and mortise cuts in wood.

Just clamp a guide to the wood. Set depth ring. Start cut at 45° angle and work Electrichisel back and forth along guide.

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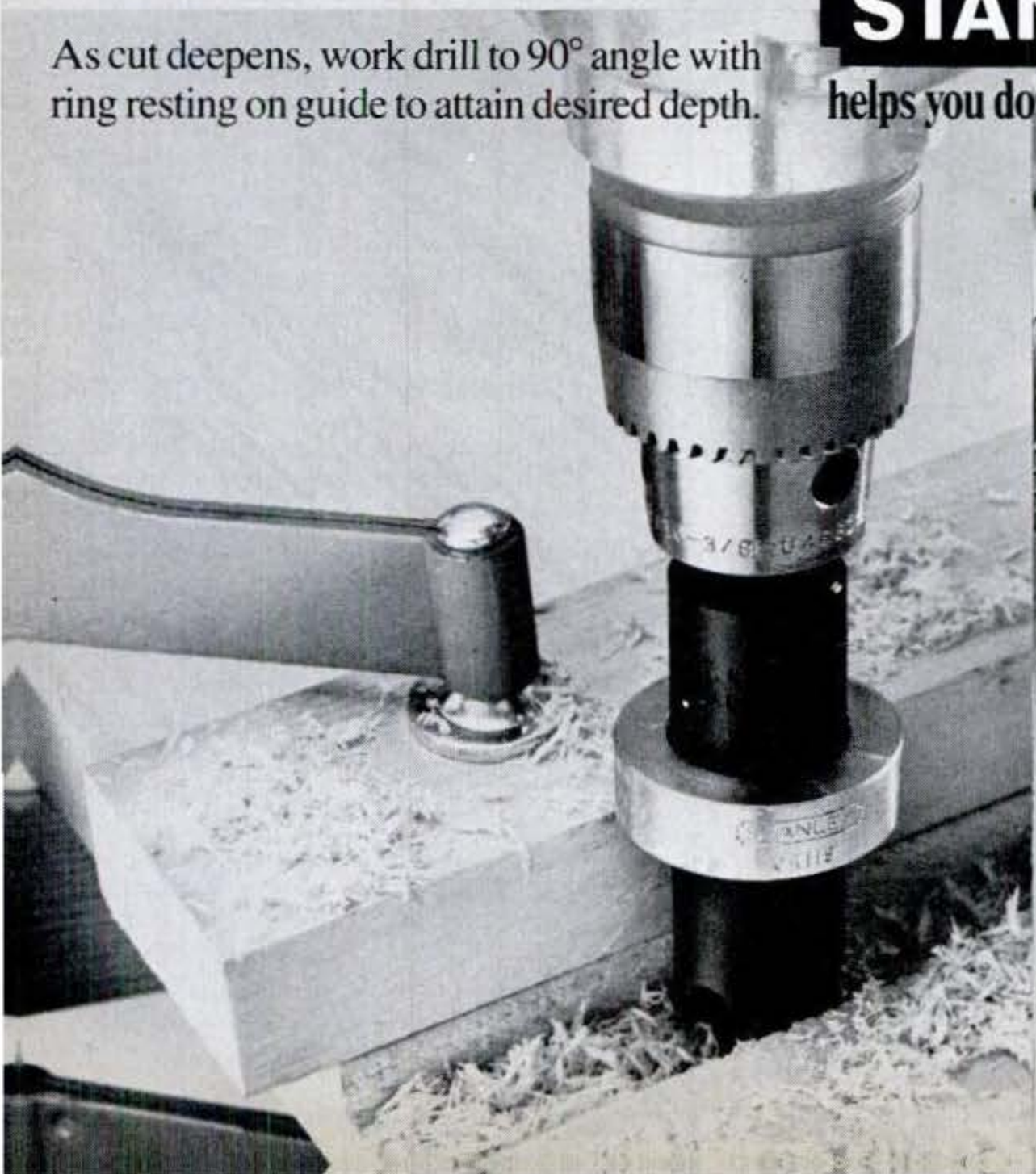
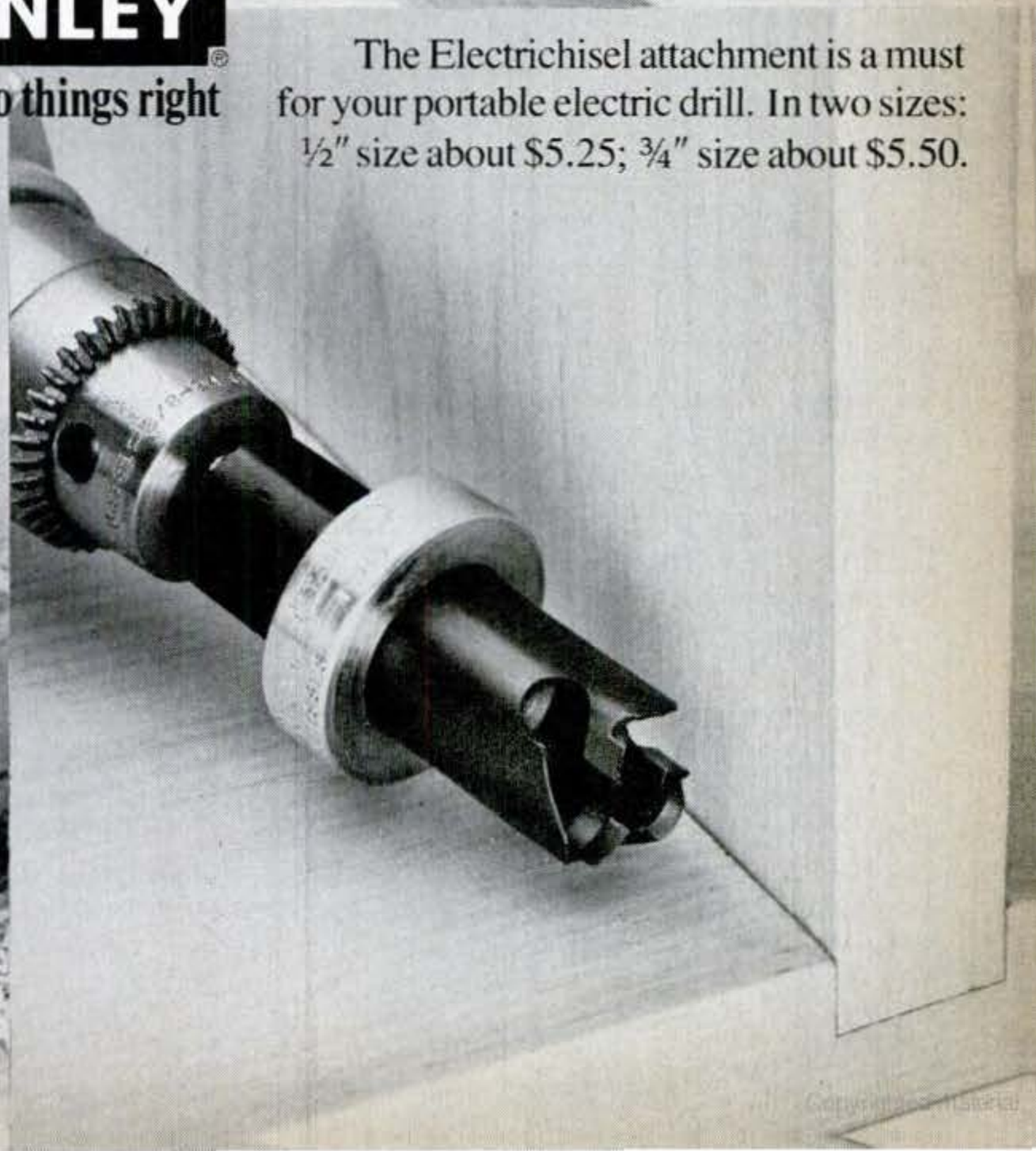
As cut deepens, work drill to 90° angle with ring resting on guide to attain desired depth.



The Electrichisel attachment is a must for your portable electric drill. In two sizes: ½″ size about $5.25; ¾″ size about $5.50.



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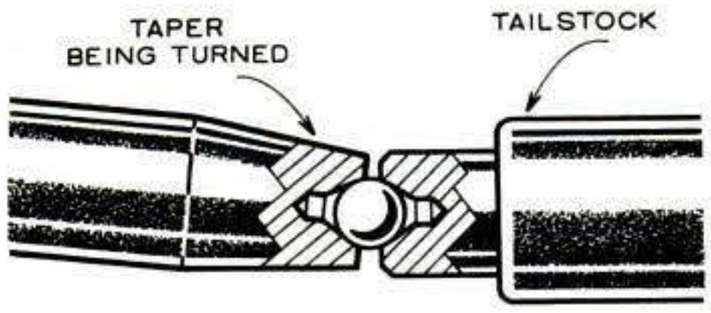
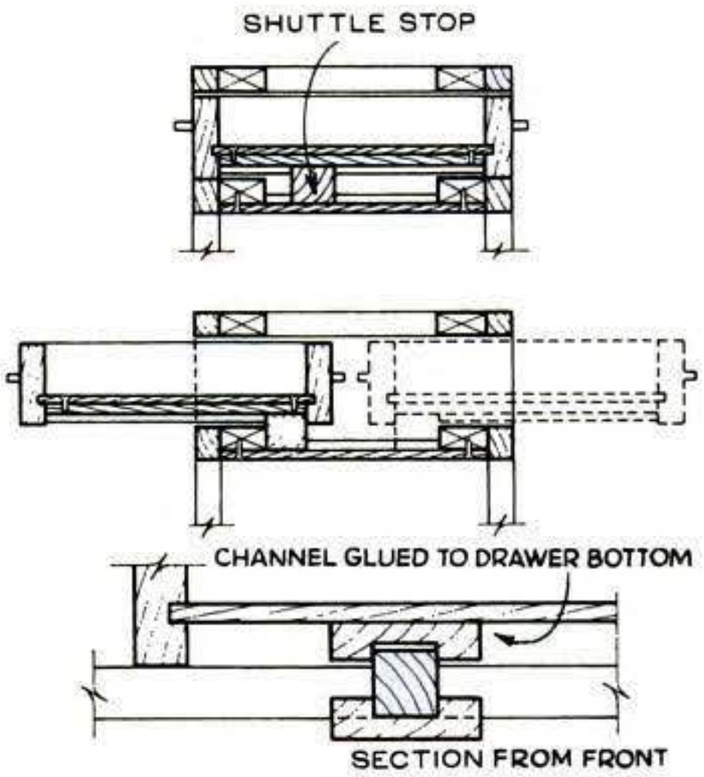
SHARED BY PS READERS



Taper-turning trick

A simple-to-make ball-and-socket joint is the key to turning tapers with the lathe tailstock set over. It takes minutes to make, yet supports the work firmly and lets it turn smoothly at high speed. To make one, drill the end of the workpiece and the tailstock center. Use a large center drill. Then slip a 3/8-inch ball bearing between the two parts and lubricate the joint. Tighten up on the tailstock handwheel to create slight pressure—enough to remove any free play, but don't overload the ball joint. Too much pressure is better than too little. Any free play will have a detrimental effect on the accuracy and the finish of your turnings.

C. W. Woodson, Herod, Ill.



Two-way drawer stop

A good way to get your day off to a bad start is to pull a drawer too far out, dumping its contents all over the floor. A simple drawer stop is the answer—and here's one I came up with that works even on two-way drawers. I call it a "shuttle stop." Sketches above show how it's made. The only trick is determining the size to make the stop, and this depends on the nature of your cabinet and drawer framing. It's simplest to start with a stop that's too long, then cut it down by trial and error until it lets the drawer open about ½ to ¾ its depth. Make the parts a loose fit and lubricate with wax to avoid extra friction.

Brian Johnson, Sacramento, Calif.

FALL GOLDEN VALUE DAYS at Hardware-Housewares Stores

Popular Science Plans, Dept. Ap
380 Madison Ave., NYC, NY 10017

- ☐ The Big Barn (5589) $4.95
- ☐ Redwood Patio Furniture (5590) $2.50
- ☐ Dome Kit (5595) $19.00
- ☐ Fun Dome (Plan 5580) $1.00
- ☐ Plans Catalog 25¢ (refunded with next order)
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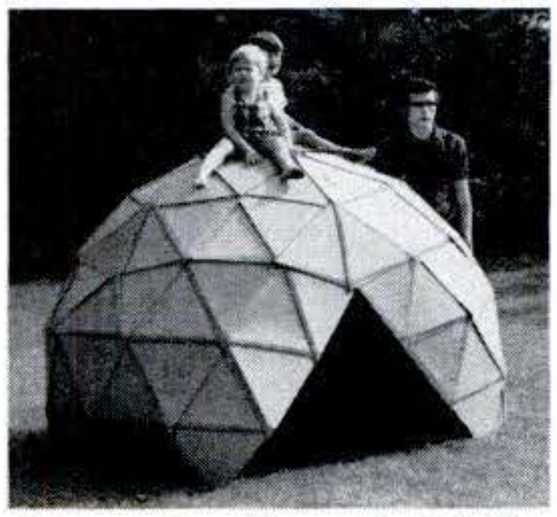
New Plans for Yard and Patio

Dome Kit

It started as a serious study in dome geometry but became so much fun we know you'll want one too. Kit includes die cut and scored triangles of corrugated cardboard you join with staples or glue. It's not just a plan but a complete dome. Amazingly strong. Can be waterproofed easily. Instructions illustrate triangular and hex doors, windows, vents. The shingle effect of overlapped edges aids in waterproofing when dome is painted. The triangles can also serve as templates for a more permanent plywood



dome. The dome is biodegradable, thus handy for campers and backpackers. Fifteen die cut sheets and printed instructions; Dome Kit, Plan 5595, $19.00. An unusual Christmas gift!

Fun Dome

A midget 5/8 dome of hardboard with metal corner gussets that still gives you standing headroom. Originally a playhouse, but big and strong enough for a main camp on a wilderness trip — it knocks down to fit in a car trunk. Plan 5580 reprints the PS article (dimensioned drawings and instructions) plus additional photos on one 17x22" page; $1.

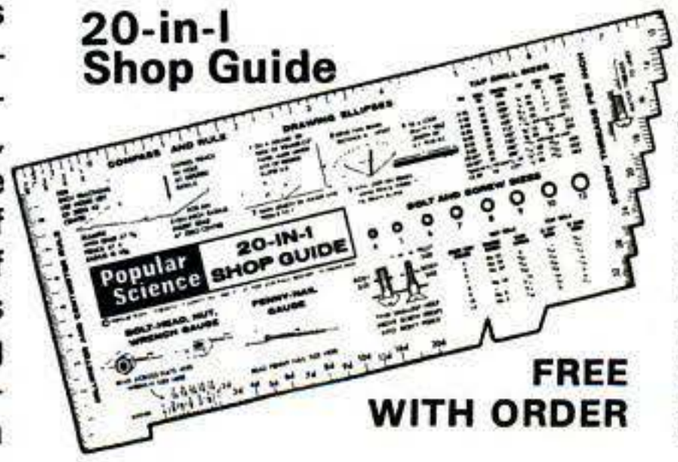
Patio Furniture

Make it of redwood. Give it a natural finish and you'll have a set of bright looking pieces that are light enough to wheel around easily — the chaise weighs only 36 pounds complete. These reprints from PS give you assembly details for the chaise longue, a one-legged patio table, stools, barbecue, settee, coffee table, arm chair, and a miniature wheelbarrow planter. Three of the pieces contain waterproof storage spaces. BONUS: This plan set includes a matching porch swing design and instructions for building a double gate into a wooden stockade fence. Plan 5590; Redwood Patio Furniture; $2.50

Big Barn in Pennsylvania Dutch Style

Multi-purpose barn in traditional style measures 14' x 20' in floor space. Developed as the answer to reader requests for more storage space and a larger work area with potential for recreation. Far from an eye-sore, the design of the exterior adds pleasantly to your property. The simplicity in design will be appreciated by the builder. The ventilation, sun-light, wide doors, and the extended front beam for chain-hoist all make the barn practical for many uses. Double-doors have seven foot opening. Side door is a Dutch style and opens half at a time. Windows slide open. Plan for window box is included. Three 24 x 30" blueprints; one 17 x 22" page of photographs of critical points of construction; plus a 17 x 22" page of a materials list, construction steps, and instructions for concrete foundation; Big Barn, Plan 5589, $4.95.

20-in-1 Shop Guide



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For easier launching:

TWO FOR YOUR TRAILER

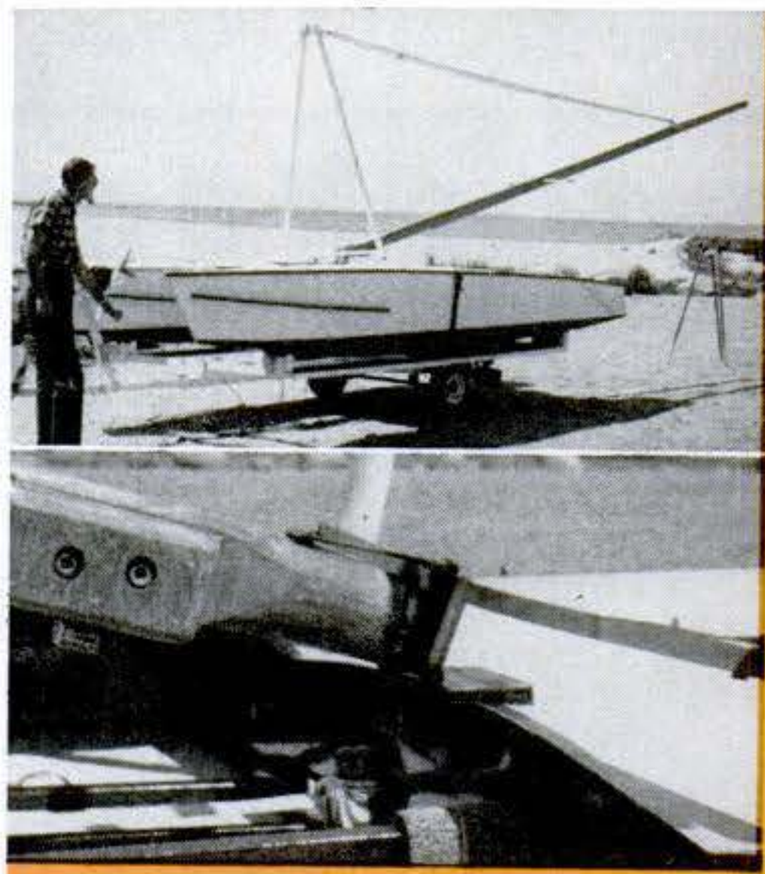
MAST HOIST

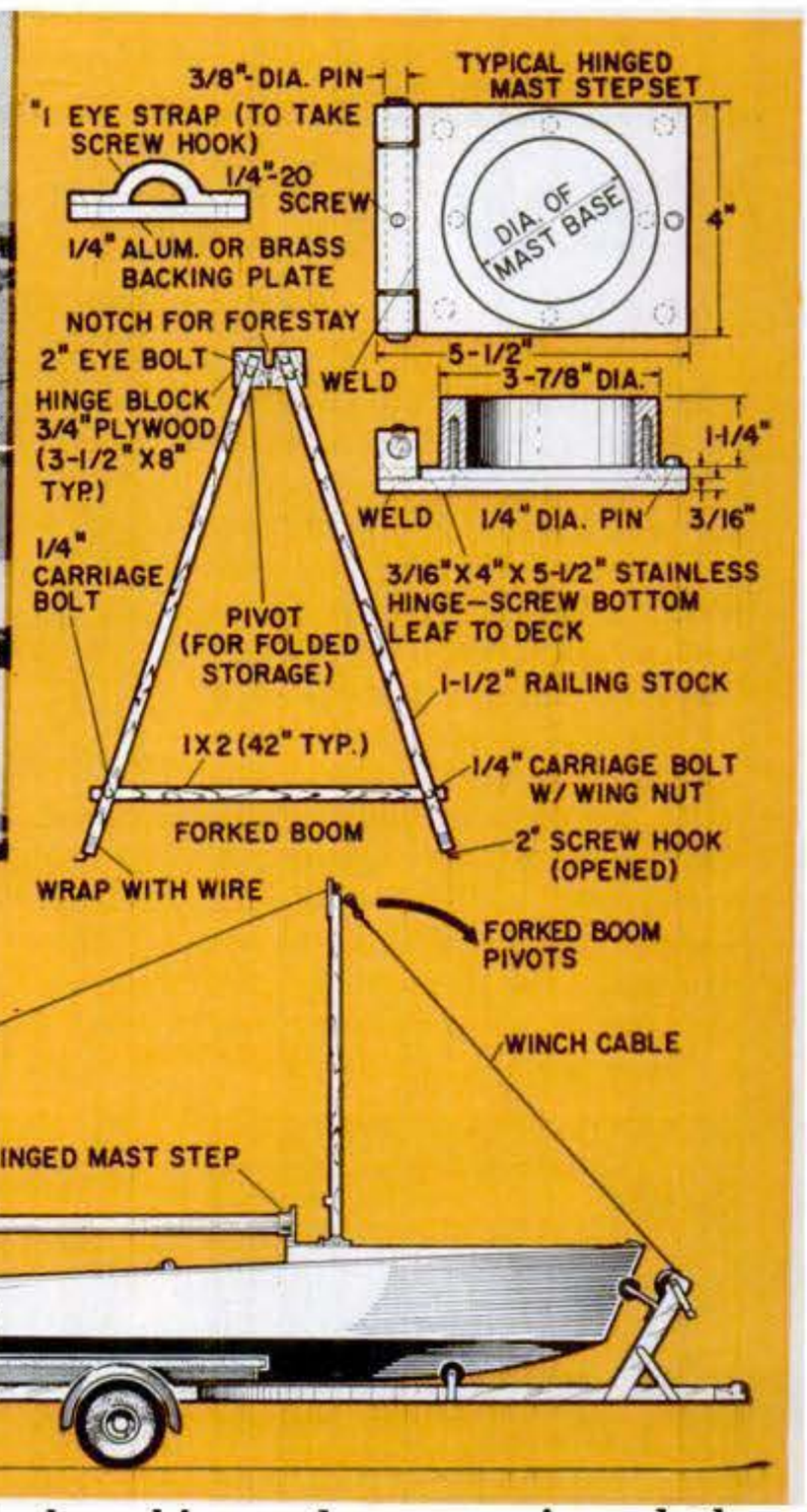
The winch on your boat trailer can do double duty when you have a mast to step. A few easily made accessories let you use it to hoist the mast while the boat is on the trailer.

Instead of stepping the mast in a socket fastened directly to the deck, you attach the socket to a stainless-steel hinge. This can be homemade as shown at upper right, or purchased at a marine-supply house.

Next, make a forked boom from 2" fir railing (2-by-2s would do as well). L hooks screwed into the bottom of both uprights engage eye straps that are fastened to the gunwales just forward of the mast. The height of the fork should be slightly less than the distance from the eye straps to the forestay stem plate. The lower brace is lightly bolted in place to prevent collapse after the L hooks are inserted. To support the upper end of my 24½' spruce mast prior to lifting, I made a folding tripod with a padded saddle, as detailed in the sketch.

To raise the mast, insert its base in the socket of the hinged step and attach the lower terminals of the side stays to the chain plates. You can expedite this by using stainless-steel safety clips instead of cotter pins for securing the clevis pins. Now, engage the lower terminal of the forestay in the slot of the hinge block on the forked boom, and hook the winch cable to the eyebolt.





Winch the pivoting boom forward to rest on the deck. When the mast is nearly vertical, you grab the forestay and attach its lower terminal to the stem plate. Then remove the forked boom and tripod and secure them at a convenient place on your trailer after launching and your car is parked.

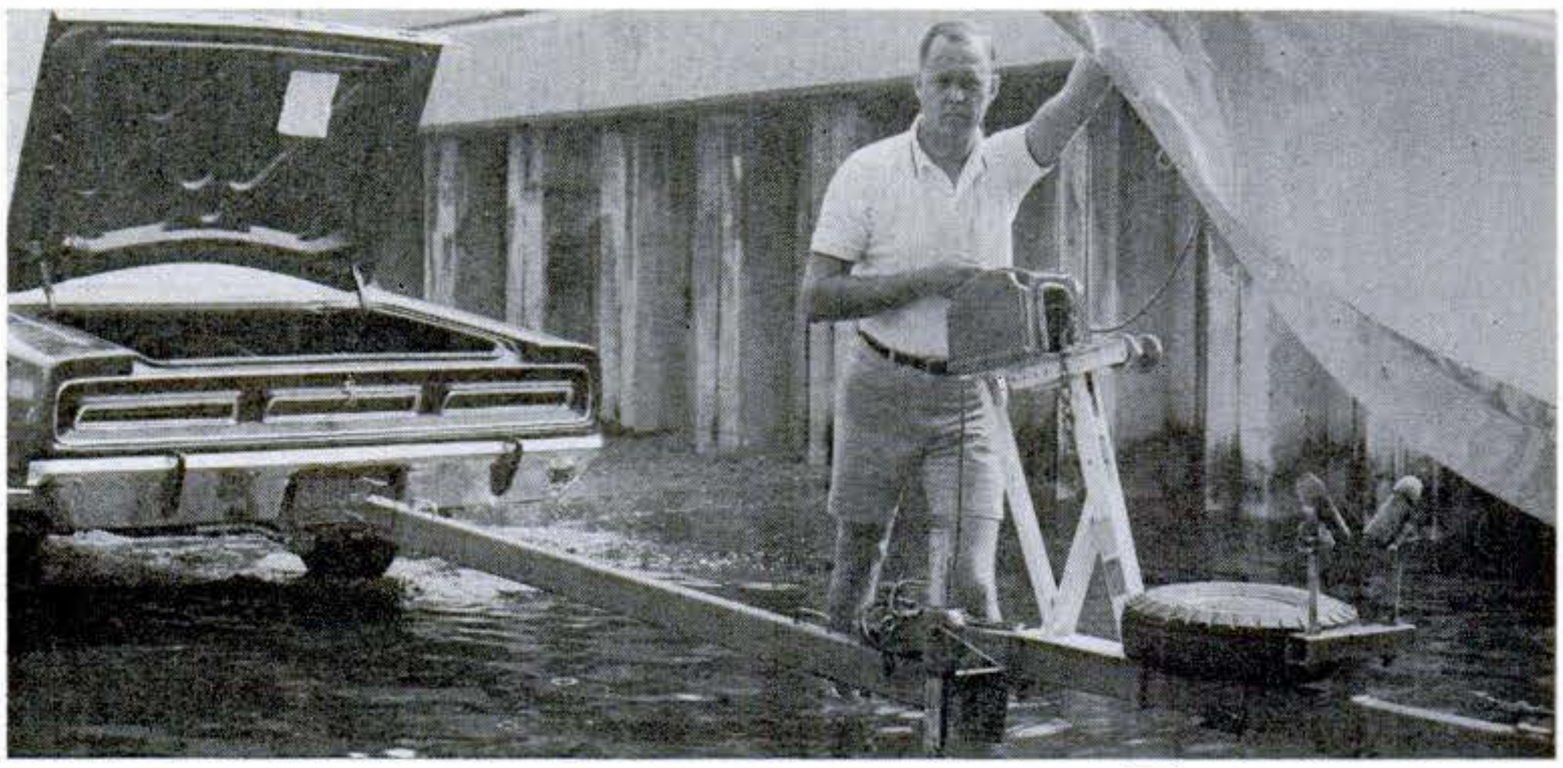
While trailering, mast and boom should be properly supported and secured. Stretch the stays along the mast and fasten with sea-ties, enclosing the lower terminals in a cloth bag. —*P. G. Burman*

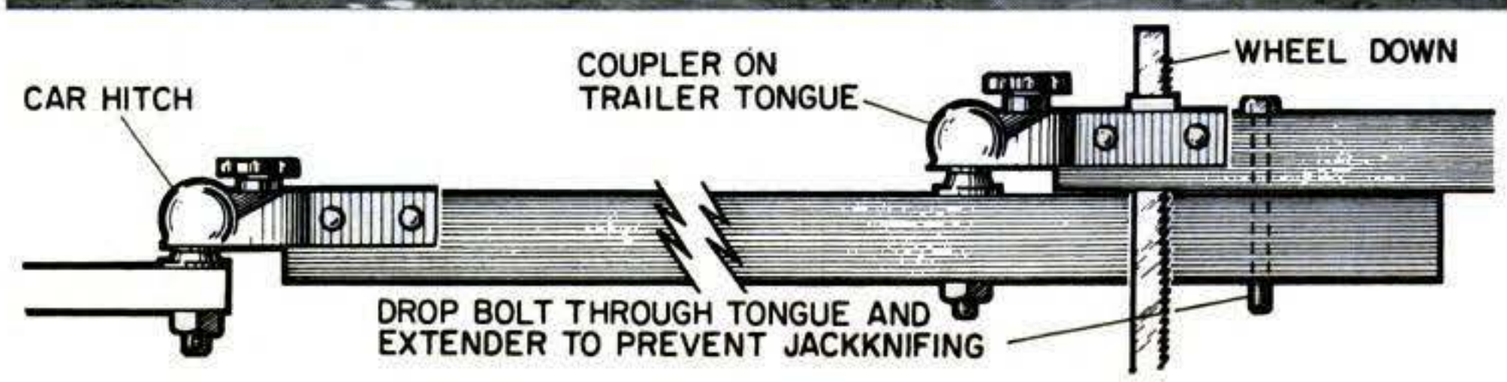
TONGUE EXTENDER

No need to be a prisoner of the tide. The extension beam I made for my trailer tongue now lets me put my inboard-outboard runabout eight feet farther down the ramp. Before, I could launch only at high tide—now I can float the boat off anytime I choose, without backing my car wheels into the water.

I just bolted a trailer hitch and ball at opposite ends of an eight-ft. length of channel iron. This fits between the ball on my car and the regular coupler on the tongue. On the road, I store my extender on two supports on the side of the tongue.

To prevent jackknifing as you back, the channel should be extended beyond the tongue coupler and secured so it can't pivot. The method depends on your trailer construction; you may not need the bolt.—*Peter J. Rose*





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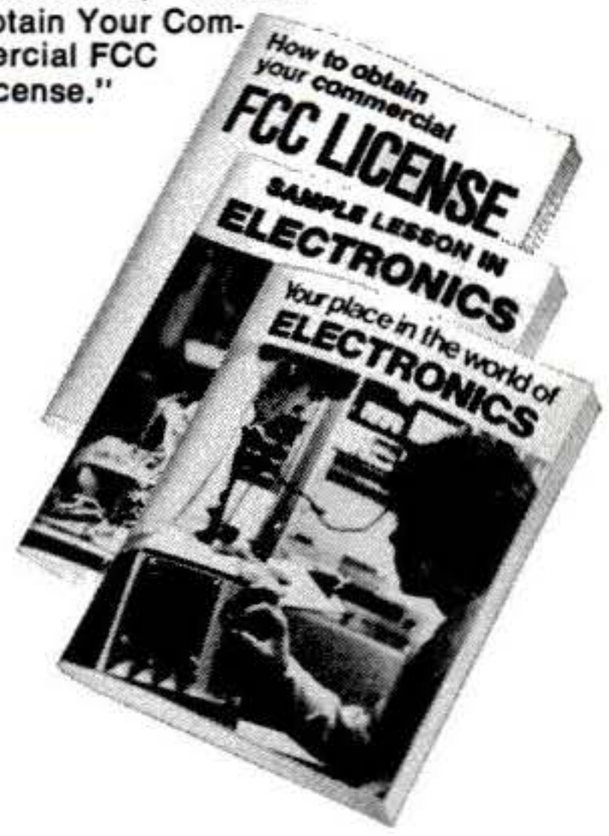

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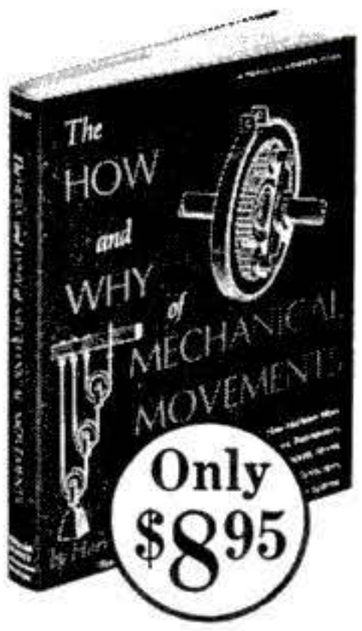

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Sealing Air Leaks

[*Continued from page 131*]

Unless properly installed, the material is also subject to gapping problems created by cold-weather contraction of the wood.

You can buy weatherstripping kits with closed-cell vinyl foam glued to a pine molding, or a strip or tube of vinyl gripped in an aluminum extrusion. These kits usually contain sufficient quantity to weatherstrip the sides and top of one standard-size door. Two seven-foot lengths and one three-foot length are provided, plus nails or screws.

The cost of such kits is high, ranging from $1.95 to $3.50. Although home owners often buy them for weatherstripping sound doors, they could do an equally effective job for less money by using self-adhering foam tape. Save the kit for warped doors. As for choice of types: There's a tendency for wood and foam to separate. Aluminum and vinyl strips hold up better.

• *Weatherstrips for casement and jalousie windows.* These are specialty items. Weatherstrips made for jalousies are in the form of vinyl gaskets that snap onto the edge of each louver. The gasket may be held in place, if necessary, with household cement.

Two companies that provide this weatherseal are Pemko Mfg. Co., 5755 Langregan St., Emeryville, Calif. 94662, and Thermwell Products Co., 150 E. 7th St., Paterson, N.J. 07524.

Weatherstrip for casement windows is either vinyl or aluminum snap-on pieces that are made for all sizes of windows (two light, three light, or four light). One manufacturer is Thermwell. Another is Macklanburg-Duncan Co., Oklahoma City, Okla. 73125.

Stationary cracks

• *Caulking cord.* This material—also called rope caulk—comes in rolls and is pressed in place with your finger. It's inexpensive, easy to apply, and lasts as long as you want it to last.

Its one drawback is that once you disturb it, you destroy it. This is the reason we can't endorse it 100 percent for use around windows, although many home owners who keep windows closed all winter do use it. It can, in such cases, be removed and stored for reuse the following season. But if you attempt to open the windows with it in place, you tear it to shreds.

In nonmovable cracks, such as at shoe moldings and around air conditioners, this material has no peer. It's better than an interior acrylic latex caulking compound from a cartridge since the latter is more difficult to apply neatly. Once in place, you can paint caulking cord to match the wall color, thus making the material unobtrusive. The cost is low: A 90-foot roll that will weatherstrip the equivalent of six windows runs about $1.65. And it lasts forever if undisturbed; I've seen the stuff doing its job 20 years after it was applied for a permanent seal.

• *Transparent weatherstrip tape.* This product has the same characteristics as caulking cord except that it needs no painting—the tape is hardly visible when installed. However, tape costs practically double the amount of caulking cord (a 1″ by 45′ roll runs $1.35).

Door bottoms

There's little really new in door bottoms. [One exception: see Schlegel system, June '73 PS, p. 119.]

Door bottoms can be divided into two categories: door sweeps and threshold types. A door sweep is attached to the face of the door along the bottom so its vinyl flap projects over the crack; threshold types are attached to the bottom of the door and/or to the threshold—an installation that requires removing the door from its hinges.

• *Sweep-type door bottoms.* Door sweeps range from about 85¢ to $1.50. You can buy a door sweep to fit door widths up to 36 inches. Most door sweeps have slotted holes, so that screws can be loosened and the device dropped as vinyl wears.

One form of door sweep being sold is dubbed "automatic," because it lowers when the door is closed and lifts when the door is open. The feature that makes the sweep "automatic" is a nylon nub which is attached to the door frame. The flexible door sweep strikes the nub as the door is closing so the sweep rides downward. Such sweeps sell for between $2 and $3 and are used primarily when carpeting beside the threshold would make use of a regular door sweep impossible.

• *Threshold-type door bottoms.* These make a much better weatherseal than door sweeps, but they are more difficult to install. Generally, the door has to be removed and its bottom edge trimmed back.

Threshold-type door bottoms cost from $1.95 to $6.00; the more expensive, the more complex. One costly but effective type (see sketch) incorporates a door bottom, aluminum threshold, sweep, and drip cap. PS

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The Mossberg Way

Model 810 Series: lean and hungry for the long hunt.

It's hit or miss. When you stalk big game, you usually get only one shot at success. And accuracy isn't improved one lick by all the expensive frills and fads and engravings in the world.

We've put first things first with our Model 810 Series: the hunt.

You get the exceptional, pre-tested accuracy of Ac-Kro-Gruv 8 groove rifling. A vault-tight bolt with four in-line locking lugs. And meaningful features such as a foolproof safety, adjustable trigger, choice of box magazine or hinged floor plate, and optional 4-power scope. In four calibers: .30/06, 7 mm Magnum, .270, and .338 Magnum.

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IF YOU CAN USE ANY OF THESE TOOLS...

...you can build yourself a Bell & Howell solid-state 25-inch diagonal color TV... and maybe build a whole new future while you're at it!

"Electro-Lab" is a registered trademark of the Bell & Howell Company.

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If you're already handy with a set of tools, here's a way to pick up a pretty thorough knowledge of electronics: build yourself a solid-state color TV as part of a complete learn-at-home program from Bell & Howell Schools.

This important project gives you valuable "hands on" experience with solid-state circuitry—the kind of *practical* experience you'll need to build a successful career. It's a vital part of your total electronics education.

Once you've completed your program from Bell & Howell Schools, you could have an exciting career opportunity waiting for you in the growing field of home entertainment electronics. You might even end up with a business of your own in color TV servicing.

Fix stereo systems . . . FM-AM radios . . . phonographs . . . tape recorders

With your new skills, you can build and service stereo-hi-fi systems—including FM-AM radios . . . phonographs . . . open reel tape recorders and cassette or cartridge player/recorders. You could even build yourself a complete "home entertainment communications center"—complete with the new gadgetry of cartridge television when it comes out. The skills you build by following this unique program are more than enough to service almost *any* type of home entertainment electronics device.

A complete at-home learning program in home entertainment electronics

Your color TV project is probably the best way for you to learn the most advanced "state of the art" concepts of sophisticated electronics circuitry. It's part of a complete at-home learning program prepared by skilled instructors at Bell & Howell Schools. Mail the postage-free card today so that our representative can bring you all the facts at no obligation.

It doesn't matter if you've never had any training in electronics before. Nobody's going to start throwing "diodes" and "capacitors" at you right off. You start with the basics. You take it one step at a time. You walk before you run. And you'll be amazed at how quickly you start to feel comfortable with things that seemed complicated at the beginning.

Attend special "help sessions" if you like

In case you run into a sticky problem—or you want to discuss your project with an instructor—come in and see us. We've scheduled special "help sessions" regularly at the Bell & Howell Schools and in many other cities throughout the U.S. and Canada. Drop by. Meet an expert instructor in person. Talk over any rough spots with him—and with other students. You'll enjoy the chance to "talk shop."

Master the most up-to-date solid-state circuitry

Solid-state is here to stay. Not just color TV but almost every type of electronic device will eventually move farther and farther in the direction of *total* solid-state circuitry. Get to know the most advanced "trouble-shooting" techniques for these sophisticated circuits. You'll find an almost irresistible demand for your skills.

Why you *should* know electronics

No matter where you look, the amazing technology of electronics is becoming a bigger and bigger part of the picture. More and more automotive parts and diagnostic instruments are electronic. Many large manufacturing plants use sophisticated electronic systems—controlled by a few skilled electronics technicians. The increasing use of two-way radio . . . the huge promise of cable television . . . the astonishing growth of electronic data processing all open doors to exciting new career opportunities for the man with thorough training in electronics. In fact, the day may come when the man who does *not* have electronic skills will be severely handicapped in many industries.

Why you should get your training from Bell & Howell Schools

Skilled instructors at Bell & Howell Schools—carefully selected for their knowledge, experience and teaching ability—plan each program with the utmost care and attention. Each year, they spend over $200,000 improving programs to keep them up-to-date with the latest technology. Many Bell & Howell Schools graduates have used their home study training to get started in exciting new careers or businesses of their own in electronics. You could too!

With your first lesson you get...

...the Laboratory Starter Kit! A volt-ohm-meter (VOM) with design panels, modular connectors, experimental parts and battery power source. Gives you *immediate* "hands on" experience with your very first lesson.

You also build and keep the exclusive Bell & Howell Schools Electro-Lab® electronics training system

To make sure you get practical experience with instruments used daily by professionals, you build yourself a Design Console, an Oscilloscope and a Transistorized Meter (see details at right). These are the three instruments you'll work with constantly—both during your program and thereafter.

CONSIDER THESE ADVANTAGES:

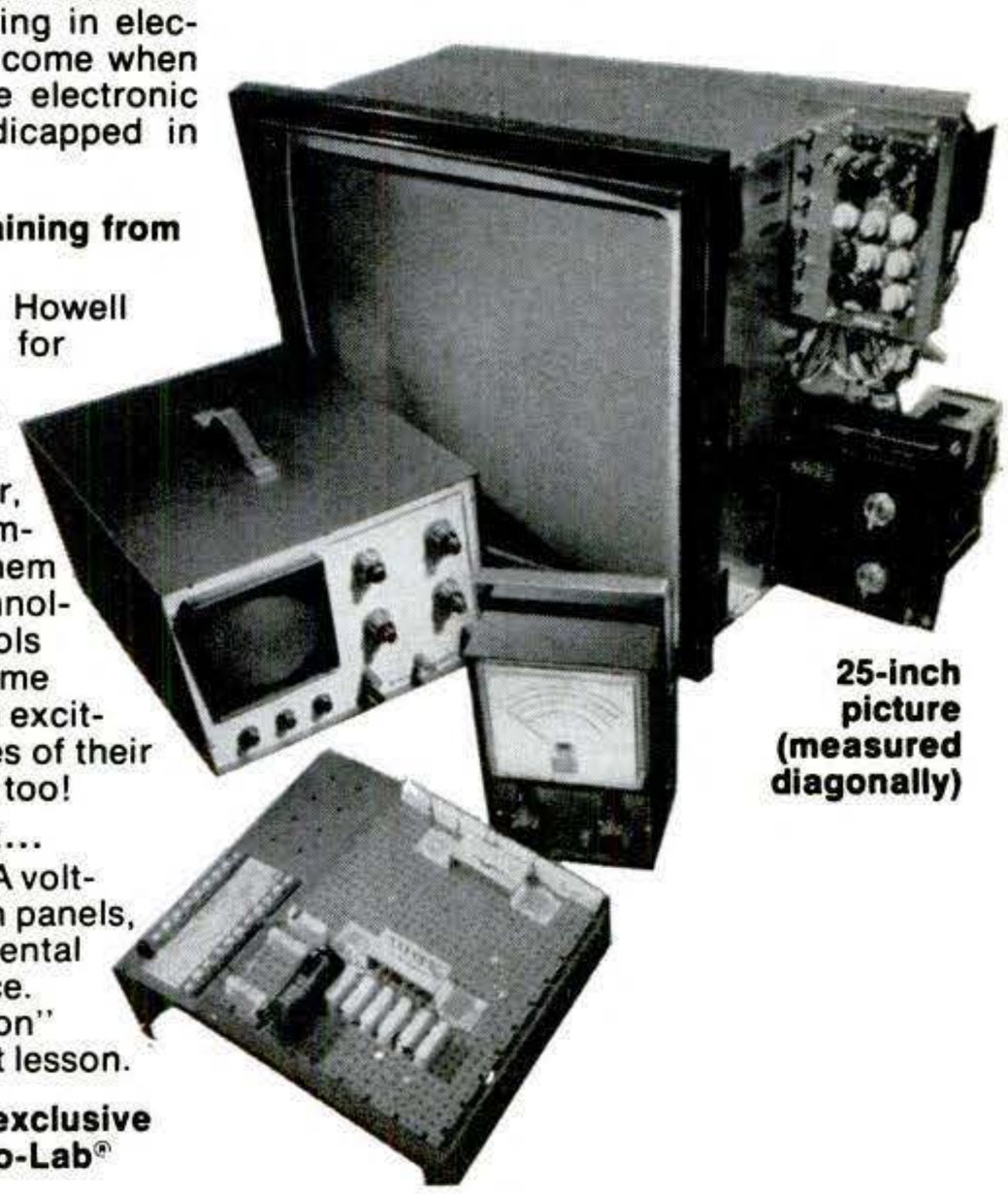
Help Sessions We've scheduled special "help sessions" regularly at the Bell & Howell Schools and in many other cities throughout the U.S. and Canada. Top instructors give you expert advice and you meet other students, too.

National Career Placement Center
When you complete your course, we will help you in your search for a job in a field of electronics that fits your background and interests. Although we cannot guarantee jobs to our graduates, this placement service is available at *any* time after you graduate.

Veterans' Benefits We are approved by the state approval agency for Veterans' Benefits. Check the box for details.

Student Financial Aid We are an eligible institution under the Guaranteed Student Loan Program. Check the box for details.

Detach postage-paid reply card and mail today for Free Information!



25-inch picture (measured diagonally)

- **Bell & Howell Solid-State 25-inch color TV.** Ultra-rectangular tube . . . 25-inch picture measured diagonally . . . full 315 square inch viewing area. Solid-state modular circuitry . . . 4 advanced IC's . . . 100 transistors . . . 72 diodes . . . individual plug-in circuit boards. Special UHF/VHF tuning features . . . built-in self-service components.
- **Design Console** Use this to rapidly "breadboard" circuits without soldering. Equipped with built-in power supply . . . test light . . . speaker . . . patented plug-in modular connectors.
- **Oscilloscope** Portable 5-inch wide-band oscilloscope offers bright, sharp screen images . . . calibrated for peak-to-peak voltage and time measurements . . . 3-way jacks for leads, plugs, wires.
- **Transistorized Meter** Combines most desired features of vacuum-tube voltmeter and quality multimeter. Registers current, voltage and resistance measurements on a large, easily-read dial. Features sensitive, 4-inch, jewel-bearing d'Arsonval meter movement.

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Jock itch (or chafing, rash, itching, sweating) shouldn't be treated lightly.

If your groin, thighs, or buttocks suffer from redness, rash, chafing, soreness, excessive perspiration, or Jock Itch (Tinea cruris), then you need medicated Cruex®.

Cruex provides fast relief. It soothes itchy, inflamed skin. Absorbs perspiration. Helps cushion against further irritation. And, because it's medicated, Cruex is strong enough to help prevent the fungous infection that can develop when these annoying symptoms are improperly treated.

Since Cruex is a spray-on powder, it penetrates into hard-to-get-at places so you avoid the sting and burning of rubbing, dabbing, or smearing on ointments, creams, or powders.

Get relief—fast. Avoid embarrassing itch, too. With Cruex. Soothing, cooling Cruex.

Cruex. Guaranteed to work or your money back.

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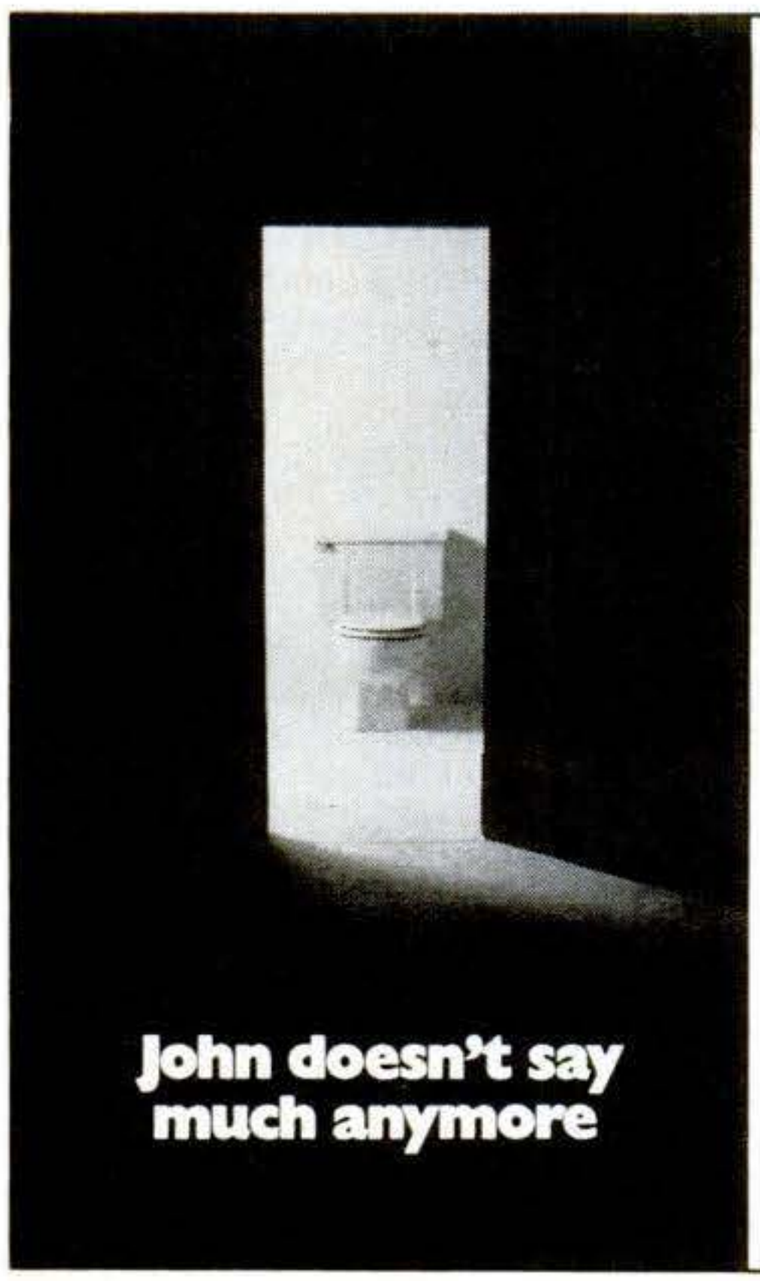


John used to leak, squeak and sometimes even whistle.

The problem was obvious: an outdated, corroded ballcock that leaked.

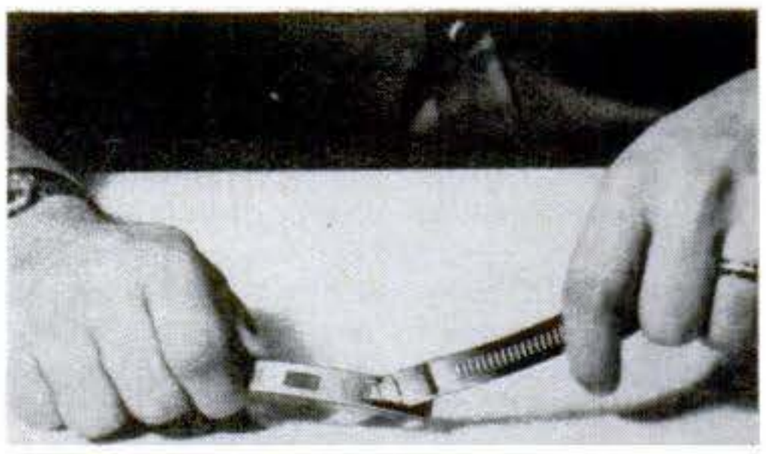
Once rid of it, John got what was coming to him. A Fluidmaster. Fluidmaster eliminates old-fashioned tank float and arm. And because it operates hydraulically, it works with water pressure, for fast, positive shut-off.

Write today for details. And change your John into the strong, silent type.

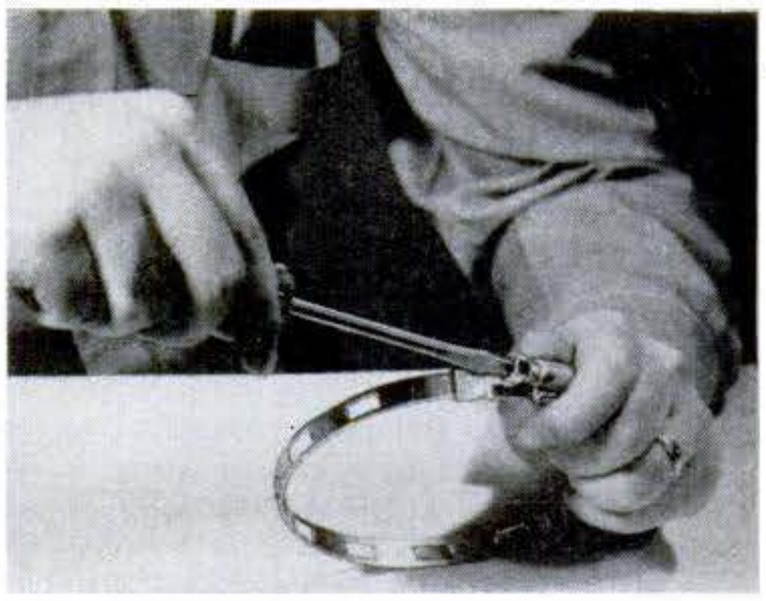
Manufacturer of the Model 100, 200 and 400.

FLUIDMASTER, INC.
1800 Via Burton
Anaheim, Calif. 92805

Cut a length of slotted band with metal shears, cold chisel, or hacksaw.



Insert serrated fastener in slot at one end, screw-housing at other end.



Engage worm-drive take-up and tighten clamp with screwdriver or wrench.

They Call 'Em Mak-A-Clamps

What's a 30-foot circular band clamp good for? Not much, maybe, but if you ever need one, you can make it at home with a kit. Of course, you can also make smaller, more useful sizes.

The Mak-A-Clamp kits from Breeze Corporations contain a roll of slotted stainless-steel band and pairs of end fasteners. Kits are available with eight-foot rolls and three sets of fasteners, 50-foot rolls and 10 fasteners, or 100-foot rolls and 25 fasteners. The clamps resist corrosion and can be tightened around any shape. Assembly is a quick, three-step process.—*M. Dammerman*

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People write to PENNZOIL

Supreme Quality · Safe Lubrication

Have a question about motor oil? Lubricants? Engines? Ask the Pennzoil experts...

Hot-Hot. I've heard engine oil has a danger point at which it can catch fire. How hot does it have to be to do that?

Too hot to ever occur while your engine can still run. For instance, Pennzoil Z-7 SAE 30 has a flash point of 440 degrees. That means the oil will not catch fire by any spark unless it reaches that temperature. Since car engines normally operate between 180-220°, an engine is much more likely to seize up before it reaches "flash point" temperatures.

Don't Oil the Gas. They've just delivered my new car with its 455 cu. in. engine. I've been told that for the first couple of tanksfull, it's a good idea to add a quart of lightweight motor oil. What do you suggest?

We suggest you keep the oil in the crankcase where it belongs. Don't add oil to your gasoline. Your car is tuned to manufacturer's specifications and adding oil to the gas might reduce the octane and could affect the performance. This would result in inefficient combustion. You could then get plug fouling, combustion chamber deposits, lack of power and perhaps more serious problems.

Heavy Smoker. My new car has more than 7,000 miles on it and it's still blowing out smoke through the tail pipe. Am I burning oil? If so, what should I do about it?

You may or may not have a problem on your hands. Some engines take longer than others to break in and that could be what's happening here. However, two other factors might be responsible for exhaust smoking—leakage past valve stems and guides or improper ring seating. Your car is probably still in warranty, have your dealer check the situation.

Correction Please. Is it better to check the oil level first thing in the morning, or after the car has been running a while?

It really doesn't matter. But, if it has been running, be certain the car sits for a few minutes before checking. This will allow the oil to drain down into the crankcase for proper measurement.

Foam. Is it true that multi-weight oils like 10W-30 tend to foam at high temperatures?

High temperatures won't usually make multi-weight oils foam any more than single-weight oils. However, you're not likely to run into foaming under any condition if you're using Pennzoil. Z-7 foam inhibitors in Pennzoil Motor Oil take care of that.

Pitted Points. I have only 10,000 miles on my new car and I've had to replace the distributor contact points. It's a 400 cu. in. powerplant, fully equipped with all kinds of smog devices. What's to blame for my points wearing out?

If the points are burned or badly pitted, check for an improperly adjusted or inoperative voltage regulator. Also look into the ballast resistor and condenser. It's also possible the points were not adjusted properly.

Oil Colors. After switching to Pennzoil in my 1965 truck, I noticed the oil had turned a darker color after only 500 miles. How come? Is there something wrong with that oil?

Everything's just fine. The oil's color reflects its cleaning action. The darker it is, the more it has cleaned. Contaminants are kept suspended in very fine particle size by Pennzoil Z-7. This highly dispersant oil may appear darker, but your engine will be cleaner and last longer because of it.

Confused. My mechanic tells me that the grease used in my car's rear-end isn't really grease at all. He also says brake fluid works because it is "hard" and the fluid in my automatic transmission is as thin as water. Does he know what he is talking about or should I take my business elsewhere?

It wouldn't hurt if he explained a little more fully, but he does know what he's talking about. For instance, automatic transmission fluids are basically light oils, treated with chemical polymers and other specially selected additives. They look thin, but change very little with temperature variations. Rear-end "grease" is really a fluid gear lubricant that could be classified as a heavy oil. Our position is that they must be extremely high-quality products to do their jobs well. At Pennzoil, they are marketed only after being carefully formulated and tested. Brake fluid could be called "hard", we suppose, because it is so difficult to compress as it moves through the hydraulic portion of your brake system.

WE'RE OPEN TO QUESTIONS about motor oils, lubricants, engines. But, you can tell *us* a few things, too. Maybe you have discovered something interesting about motor oils or lubricants. Or you may have a special reason for being a Pennzoil fan. We would like to hear from you. Write to: Pennzoil Company, Technical Service Department, P. O. Box 808, Oil City, Pennsylvania 16301. Note: sorry no pictures or material can be returned. Letters chosen for publication are subject to revision necessary for publication requirements.

Quality Products For Over 85 Years

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The Rescue of Skylab

[Continued]

space sport of running around the Workshop's 22-foot-diameter wall. Debated before the flight was whether the centrifugal force would give them enough artifical g to stride erect. It did.

The aftermath. These things followed the first Skylab mission:

- A new sail-like sunshade was spread over the hastily contrived parasol, by the second crew, in a spacewalk well practiced by then.
- Skylab is the first space project to provide for crews' rescue—and that possibility arose, when leaks successively disabled two of four sets of thrusters on the second crew's Apollo Service Module. If no more failed, study showed, safe return was still feasible. But, just in case, a five-man "rescue" Apollo was ordered readied. Two backup crewmen could fly it to Skylab and bring back a stranded crew.
- Lest Skylab have another power crisis, NASA would also ready a novel auxiliary Power Module, with two solar arrays exactly like the four of the telescope-mount "windmill." A crew's Apollo, handling it just like a moon mission's Lunar Module, could fly it up to a Skylab docking port—and plug it in to feed more power into the space station.

It would be carried aloft, if at all, on the third manned mission.

- A NASA board of investigation reconstructed what happened to Skylab during launch. To facts already noted here, it added that the lost solar wing came off about nine minutes after the shield accident, when it was hit by the blast of retrorockets that separated Saturn V's second stage. (Since Skylab by then should have reached orbital velocity, the missing wing is probably still in orbit.)

An unanticipated buildup of air pressure beneath the shield—due to "design deficiencies," the board found—forced it out into the wind stream to its destruction.

But it took no official report to make the outstanding lesson of the first Skylab mission come through loud and clear:

Man in space saved the day. He demonstrated to doubting Thomases his ability to take charge and put things to rights in a situation where an unmanned spacecraft would rapidly turn into a helpless piece of orbiting junk. Skylab's striking lesson of man's value in space will not be lost on planners of future space projects. An example: possible revision of Space Shuttle designs to allow more spacewalking in case of need. PS

Tune Your Heating System

[Continued from page 128]

should be 70 degrees and the minimum 40 degrees. If your measurements don't fall within specifications, they're easily corrected by adjusting the blower speed.

Two types of blower motors are used on most furnaces: belt drive and direct drive. The belt-drive type will have an adjustable pulley on the motor shaft. The diameter of the pulley can be increased by loosening the allen screw on the movable sheave and turning it clockwise. It can be reduced by opening the sheave. Increasing the blower speed by increasing the diameter of the motor pulley will result in a reduction of temperature rise across the heat exchanger.

When direct-drive blowers are used, the squirrel-cage fan is mounted directly to the motor shaft. Often these motors have tapped windings that allow as many as five variable speeds to be selected simply by moving a wire on the terminal board. A diagram should be pasted inside the terminal-board cover or on the furnace, showing you which windings control the various speeds of the blower. Select the one that gives you the proper air temperature rise for your installation.

Setting controls. For maximum efficiency, it's wise to consult your furnace manual for the manufacturer's recommended settings and be sure that they are adjusted accordingly. If you haven't opted for CAC (see box) on a warm-air system, then you may want to realize some advantage by reducing the temperature setting of the fan control. This thermally-operated switch determines the temperatures at which the blower turns on and turns off, and chances are it may be desirable to set it lower than its current position. Rather than turning the blower on at 135 degrees and off at 115 degrees, you can just as easily turn it on at 100 and off at 80. The moving air may feel cool if you place your hand directly in front of a register at these lower cutoff points, but the air input into the house is still quite a bit warmer than room temperature actually is.

On hot-water systems there is an adjustable control for the temperature of water in the water jacket of the furnace. Lowering this won't improve efficiency, however, since the circulation of the water is controlled directly by the thermostat.

The limit switch on forced-air and hot-water systems is a safety device and should always be set exactly where the manufacturer recommends it. Under normal conditions it won't ever come into operation. It's simply there to prevent damage to the furnace in case something goes wrong with the circulation system.

Be sure that your furnace room or crawl space is not sealed so tightly that insufficient combustion air is available for the burner, reducing efficiency by "starving" the flame because of a lack of oxygen. The owner's manual supplied with your furnace will give specific requirements, but a rule of thumb is to provide one square inch of ventilation to outside air for each 1000 Btu's furnace capacity. For example, a 100,000 Btu furnace would require a 10-by-10-inch opening. This can usually be provided simply by leaving a vent or two open, or by installing a grille in an outside wall.

What an expert should do. Combustion testing is the one sure way to be certain that you're getting all the efficiency from your gas- or oil-fired system that your installation and design limitations will allow. The tests require special instruments and knowhow. These involve measuring draft, CO_2 content, and the amount of smoke present in flue gases. The technician can use these test results to obtain the maximum design efficiency by correcting any problems that exist. He'll examine the flame pattern with a special metallic mirror. It's likely that he may want to change the nozzle and/or burner adjustments.

In some cases it might be wise to ask about "underfiring" the furnace—reducing the firing rate by reducing burner nozzle or orifice size. Since most residential furnaces are oversize, this can sometimes result in a small fuel savings, and can also add to comfort. If, on the coldest day during the winter in your area your furnace is still cycling on and off, chances are that it's larger than it needs to be. Don't try to reduce input more than 20 percent—the chances are that the heat exchanger will run too cool and premature rusting may result.

If your furnace is over 10 years old, there are possibly some new accessories that may help to improve efficiency. Modern oil nozzles have been scientifically tested and designed to squeeze the maximum Btu's from each drop of oil and new gas burners use every trick of mixing gas with air to obtain maximum benefits. But the little valve to bolt onto your heating plant that will reduce its fuel consumption by half still doesn't exist. PS

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Introducing the multi-purpose Skil Xtra-tool.

$106.70 worth of capabilities for just $49.99.

With just Skil Xtra-tool and available accessories you can do things that normally require two different tools.

Hammer-Drill	**$ 66.75***
Drive-R-Drill	**39.95****
	$106.70

Skil Xtra-tool gives you all the capabilities of a ⅜" drill with adjustable trigger speed control, forward and reverse.

But it also does what no drill can do. It scrapes, gouges and chisels. Removes paint, putty, rust. Just to name a few jobs.

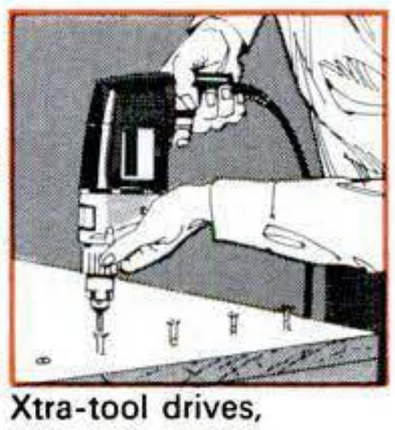
And in its hammer-drill mode, Xtra-tool drills quickly into masonry. To change mode, just rotate collar and change bit. See new Skil Xtra-tool. A drill. A hammer-drill. All for just $49.99.

*Price based on averaging of retail prices for suggested competitive products.

**Price based on Skil suggested retail price. Details available on request.

Xtra-tool chisels wood

Xtra-tool drills masonry


Xtra-tool drives, removes screws

Xtra-tool drills wood

Xtra-tool removes floor tile

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Nobody was ever sorry he bought the best there is.

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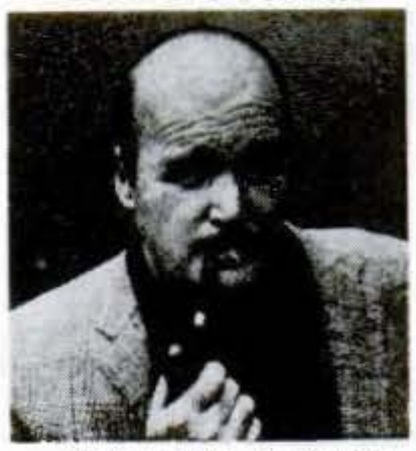
For my money and your car this is the hottest thing

SINCE ROME BURNED

PERIOD! . . . Helluva Ignition . . . . . **Tom McCahill**



Automotive Authority Noted Test Driver

When Tom McCahill tested Gaylord's Compu-Spark™ Capacitive Discharge Ignition, he said flat out: "For my money, CompuSpark's a steal. Under 50 bucks. No moving parts. Fully electronic. Solid-state. And CD, too. It's built like a brick out-house. They tried to wear one out and stopped at 270,000 miles when the car fell apart.

"What's in it for you? It virtually does away with point wear. Ends plug fouling hassles and puts plug wear **way** down the road. Often cuts your gas consumption by 20% and makes your engine run clean.

"The reasons for all this are as obvious as warts on a snake. An ultra high intensity spark is a helluva lot hotter than a stock ignition. Compu-Spark—'The Ignition System with a Brain'™—actually computes spark characteristics to engine RPM. You get the right spark at the right time **and** the right place. Darned things run great in Alaska or the tropics. Why not? All silicon, y'know. And the anti-theft feature really works!

"Another thing: Compu-Spark is guaranteed one month longer than a Rolls-Royce: 37 months free repair or replacement. 60 day money-back guarantee, too!

"Think of it this way: One skipped tune-up and CompuSpark has paid for itself. Two and you're money ahead. Three—no sweat with CompuSpark—and you're in clover, right? **You bet.**

"Order your CompuSpark now, it turned me on. I'm sure it'll turn you on, too!"

WHAT OUR CUSTOMERS SAY:

"After 7½ years of driving a 1966 Galaxie 500, I had to readjust my foot on the accelerator pedal. Thanks for a great system." E.J.D. Stratford Conn.

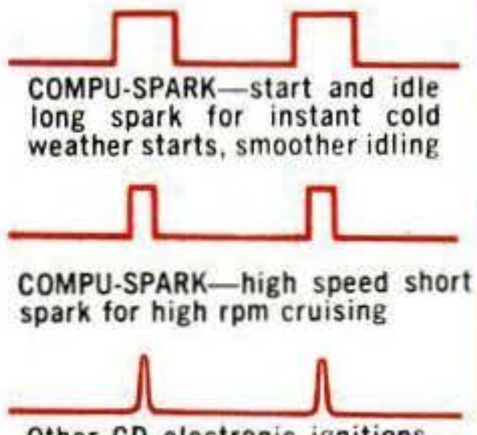
"Never in my life have I been so impressed with CDI, or any such unit, as I have been with yours." E.H.A. Redlands Ca.

"The increase in the performance of the automobile is very obvious to anyone that has a stop watch and tachometer available. It is mechanically superior to anything that I have seen on the market."
F.H.Jr. Galveston Texas

"I thought you might be interested in knowing that my CompuSpark ignition system (on my 1971 MGB) performed faultlessly through an Alaskan winter, in temperature as low as 40 below."
W.S.B. Anchorage Alaska

Made in USA

Scope Patterns Illustrate COMPU-SPARK "Brain" Features



Installs in 15 minutes

PLUS ALL THESE OUTSTANDING FEATURES

- Exclusive CompuSpark circuitry and extremely high voltage spark provides instant cold weather starts. Increases gas mileage as much as 20%
- Solid state/SCR firing provides hotter, faster spark; increased engine power and acceleration; eliminates plug fouling.
- Space age all silicon components make CompuSpark completely reliable under extreme heat or cold. No old fashioned garmanium transitors like ordinary electronic CDs.
- An instant change-over feature allows you to operate your car on either CD or standard ignition. An anti-theft feature disables the car's ignition.
- Installs in 15 minutes with any stock ignition. No rewiring necessary.
- For cars, trucks, marine and stationary engines with 12 volt ignitions.
- Don't forget—CompuSpark stays with you always. You just transfer it to your next car. Since it is all solid state with no moving parts it should outlast the lifetimes of two or three cars—irrespective of mileage.

Why did someone sit down and invent a CD ignition? To increase efficiency. Every calorie of energy is to be used to the fullest degree, especially during these days of gasoline shortage. We want you to save gas. If you get 20% improvement in gas mileage you will be driving 20 out of every 100 miles free!

Highly respected and famous John Geraghty, of Geraghty Dyno-Tuned Products Inc., Verdugo Road, Los Angeles, evaluated the CompuSpark at our request. He reported: "It really surprised our dyno and us too. At its price it's unbeatable. Closest performing units are costlier, some at $100 or more. Its quality construction is second to none. Through the entire speed range we observed definite benefits, especially at the higher range where stock ignitions tend to fall off."

Double Guarantee

Give it a fair trial for 60 days and remember our 37 month free repair or replacement policy. We will airmail you a refund check if you sincerely think that CompuSpark does not measure up to our claims and more.

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- ☐ COMPU-SPARK, ready to install @ $49.95 ppd
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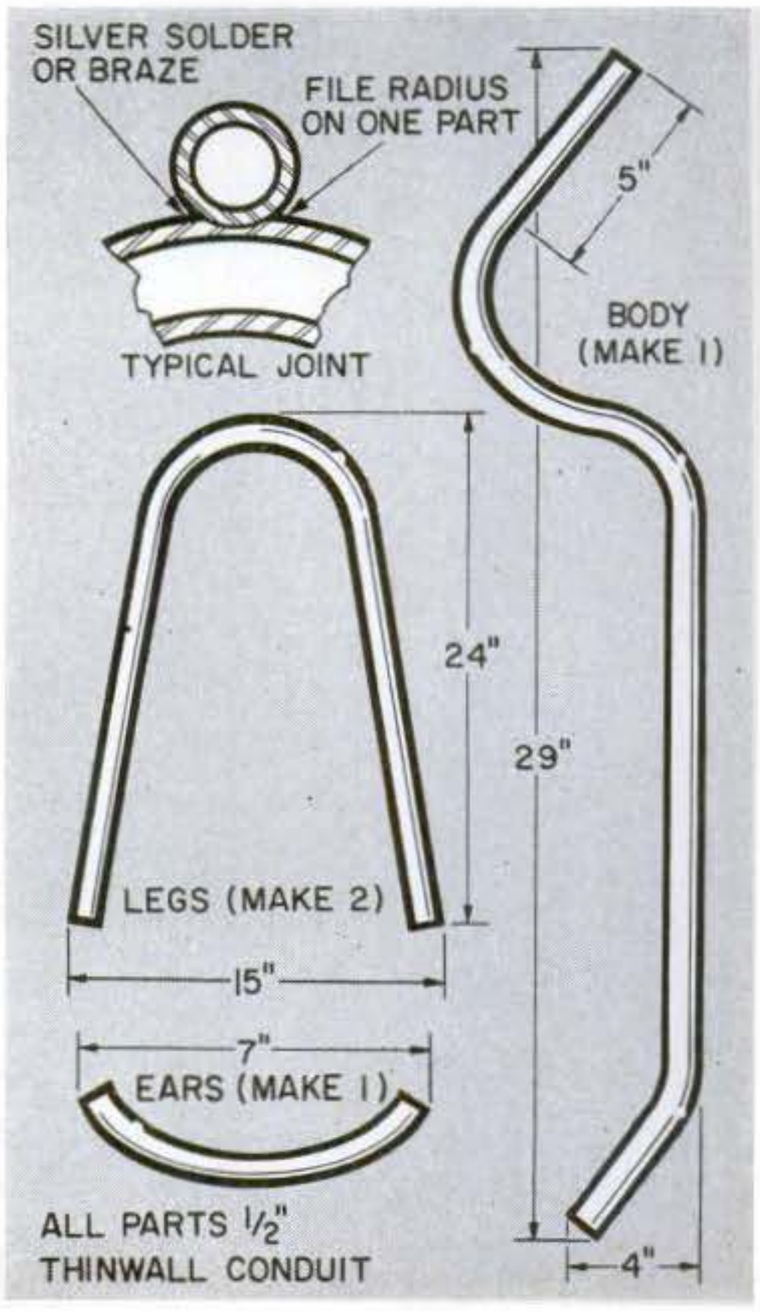

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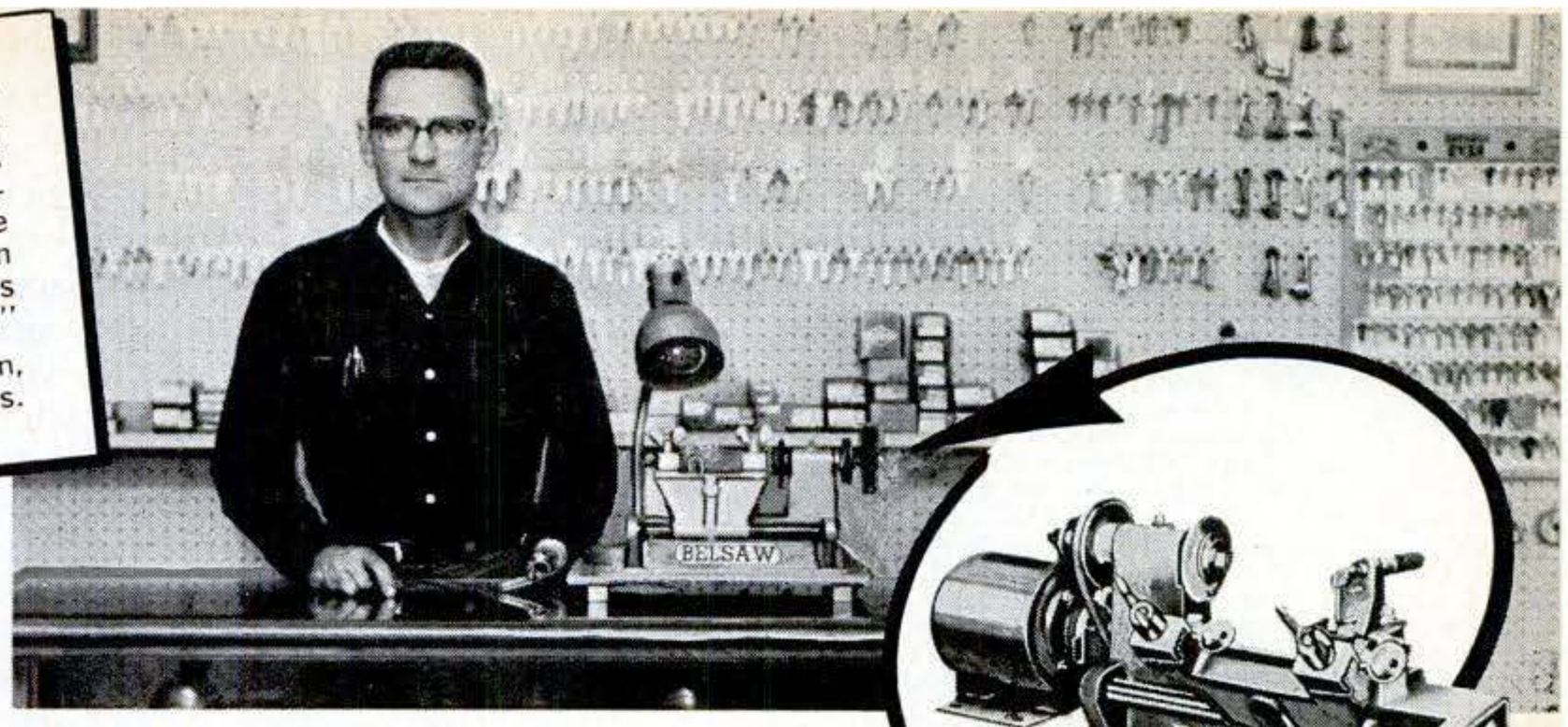

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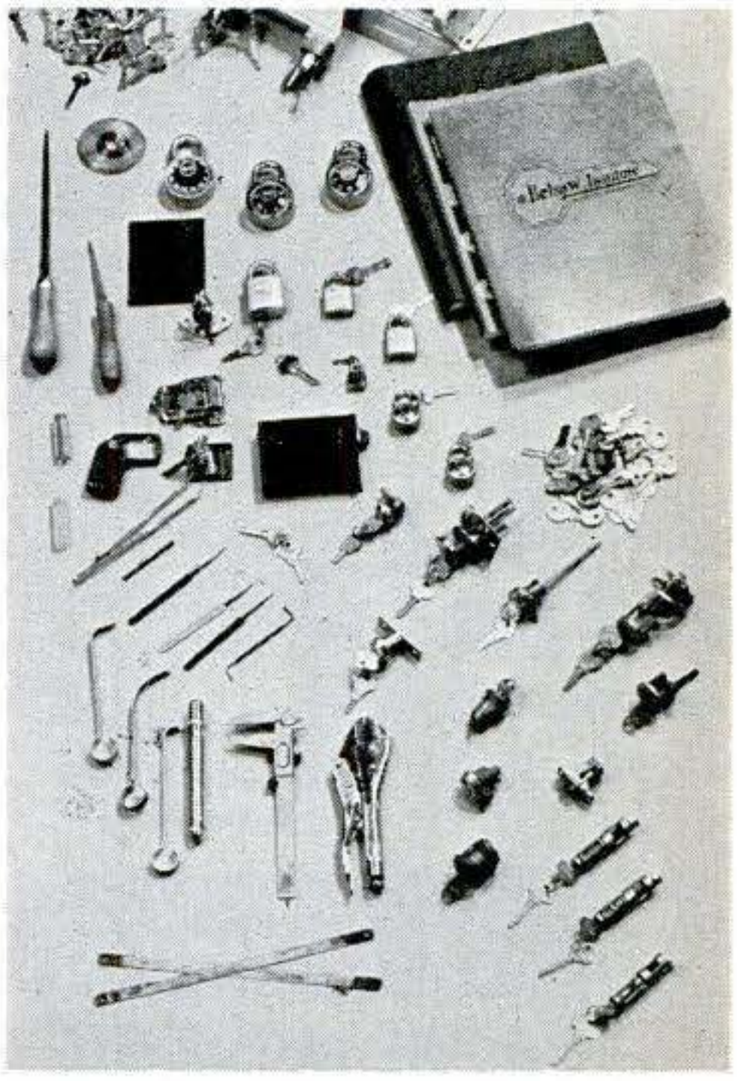

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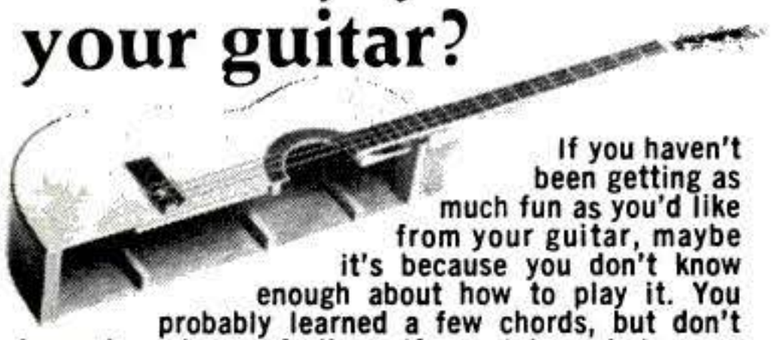

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Counterfeit Money Detectors

[Continued from page 80]

used in retail stores. But they're not the whole answer. Thus Bill Cooper saw the need for a more precise detector. That's what led to the electronic scanner, invented by Cooper and Spectronics' chief engineer, Jerry Rubler.

Cooper was reluctant to disclose the details of the invention ("so we can stay one step ahead of the counterfeiters"), but he showed me a small substrate board which contained the usual myriad of transistors, capacitors, and resistors. Jerry Rubler says it's "most of it, right there." But POPULAR SCIENCE pieced together a general description of how it operates.

How scanner works. The key to the electronic scan is in the black ink on the face of Federal Reserve notes. Since 1934, all of our currency's black ink has contained small amounts of ferric oxide. That gives the ink magnetic properties. A scan head in the machine "reads" the ink on the bill much as the head in the tape recorder translates what's on the magnetic tape. This signal is then amplified, and the machine emits both a visual and a sonic response. Cooper says the sonic response is more sensitive than the meter on old or mutilated bills where the ink has faded. You may hear the sound, but the needle may not move.

Cooper won't reveal further details, but operation is obviously more complex. There are two tests, "initial" and "prove," (to confirm "real" results on first scan), and the machine is coded for currency with large Federal Reserve seals (before 1934) and small seals (1934 to present). It won't work on silver certificates or U.S. Bank notes, but there are very few of these left in circulation.

Does the electronic scanner work like a bill changer? Sort of. Cooper says bill changers use a photoelectric scan that accounts for only one characteristic of genuine $1s. But at least one maker of bill changers, National Rejectors, Inc., uses a magnetic scan head, probably similar to the one Spectronics uses. A spokesman from National says that company's machine has a dual scan head that reads two locations on the bill.

The electronic money scanner differs from dollar-bill changers in at least two respects. First, the changers accept only $1 bills. Second, some changers will reject worn or mutilated $1s, even though they may be genuine.

No perfect solution. UV scanners are helpful, but not accurate enough. The electronic machine is excellent, but too slow for the banks and other outlets that handle large volumes of money. The Moneyscanner 1250 takes about 10 seconds to verify the authenticity of one note, more time than most banks have to spend.

Cooper's working on that, too. Spectronics sets up large UV scanners for big money handling clients. Here's how that works: First "suspect" bills are culled with a UV scanner; tellers fan large stacks of bills instead of one at a time. Any bill with even a trace of bleach is confirmed at the end of the day with the electronic scanner. Or, it can be done visually.

Yet even this system won't catch it all. Bills with no optical whiteners never would be detected. Also, a source at the Bureau of Engraving and Printing says about five percent of the counterfeits analyzed contain magnetic ink. It's possible that those could fool the electronic scanner.

How phonies are passed. But the counterfeiters themselves remain the real problem. Although they almost never exactly duplicate the government's painstaking printing (see box), they are pretty good businessmen when it comes to *passing* the money. For example, a printer is hired to make the notes. The "manufacturer" who hired him then wholesales the bundle to a distributor, usually at 10–25 percent of face value, depending on quality and quantity, and the distributor sells the bogus bills to salesmen and street passers. It may be sold three or four times before the first victim gets it (or the counterfeiters are caught).

Even with the increased reliability of the electronic scanner, most banks rely on their tellers and counters to catch the phonies visually. Officials say that experienced money handlers will notice something phony about a bill that would easily fool the average citizen.

Most people don't check. Steven Vorillas of the Off-Track Betting Corp. (OTB) says the average person is easily duped because he's not looking for anything wrong. He showed me some phonies that OTB tellers spotted readily. He says, "We tried a little experiment. We took the phonies and asked ordinary people for change of a $10 or $20 bill. They didn't hesitate. Later we stamped them counterfeit and showed

Continued

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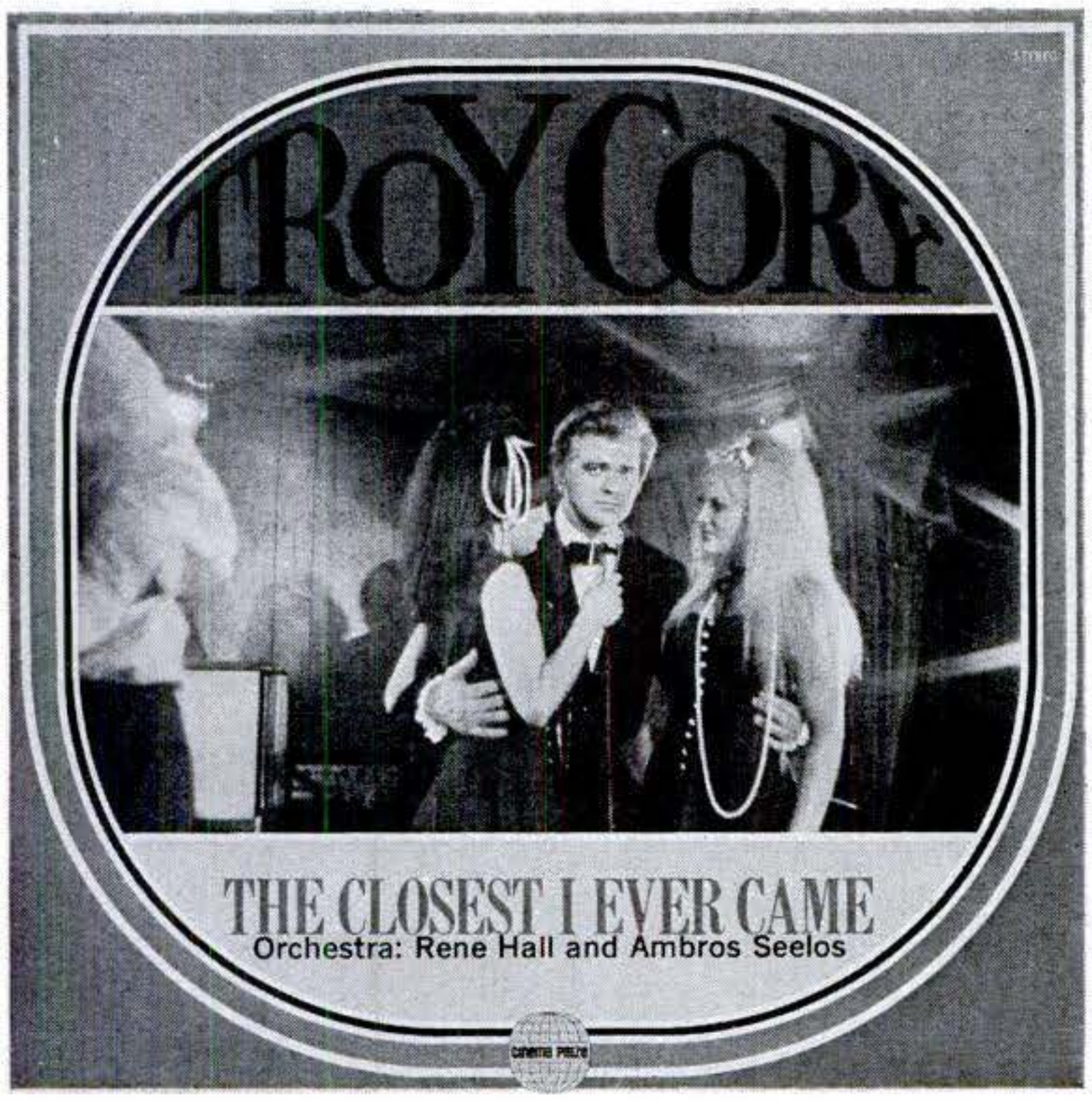

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- ★ Something
- ★ Imagine
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- ★ Kiss The World Goodbye
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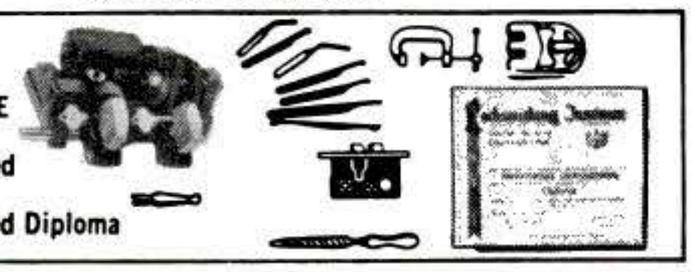

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Counterfeit Money Detectors

[*Continued*]

them the same bills. They all agreed, 'the workmanship was terrible' and 'no, I'd never take it.'" Counterfeiters correctly assume that most people don't even bother to check.

Vorillas says his tellers and cashiers catch 80 percent of the bogus bills before they take the loss. "The biggest thing for our people is the feel," he insists. Genuine currency usually feels real; bogus feels phony. One teller at First National City Bank, however, relies on the portrait. Another looks at the seals; still another checks the buildings on the back.

When a phony bill is discovered, the last person in possession gets stuck. Should your local bank teller catch it while you're at the window, he will confiscate it (as an agent of the government) and give you a receipt. Later, if it's proved genuine, your money will be returned. Otherwise, it's your loss. (Keep the receipt because it's tax deductible.) If any retailer says one of your notes is phony, he will usually give it back and ask for another. (It's your problem.) However, if he confiscates it, ask for a receipt.

Know your money. The government publishes a booklet, "Know Your Money," so you can learn where the counterfeiters make errors. If you take a minute to check, you'll spot bad print jobs and lousy paper. Unfortunately, many counterfeiters also read the booklet and make sure to print in great detail those parts of the bills that the government says are most often lacking in quality (borders, seals, and portrait, for example). Some of the good-quality phonies I've seen have excellent seals often a frequently looked-at spot.

At the moment, as the attempt to develop a really 100-percent accurate counterfeit-money detector continues, the big money handlers are relying on trained observers—as they always have—to spot counterfeits that flow their way.

The Federal Reserve Banks of New York and Philadelphia have tested various counterfeit money detectors. But they've rejected them as being impractical, inaccurate, or just not fast enough. (OTB is so busy, they're using the UV scanners just for $50s and $100s.)

This is really unfortunate.

Because the worst may be yet to come. Companies like 3M in Minnesota have color-copying machines that may tempt counterfeiters. A spokesman from 3M, when asked about the problem, admitted that the Secret Service once discussed the potential danger. About the copier he reports, "We can reproduce any color with close fidelity." Even worse, Xerox has introduced a color copier that uses any paper. (See story in this issue.)

Do we need better machines? Or better money? Mike Andress, a convicted counterfeiter and author of the book, *I Made It Myself*, thinks we need a change in our money. We don't have to change the traditional greenbacks radically, just add more safeguards like watermarks or a third pigment that reproduces poorly with offset cameras.

Chances are it wouldn't slow the counterfeiters down. They would probably find a way around newer bills. Maybe we really need electronic scanners, just a little bit better and quite a bit speedier than Bill Cooper's remarkable $450 box. Then . . . a counterfeiter might just think twice. PS

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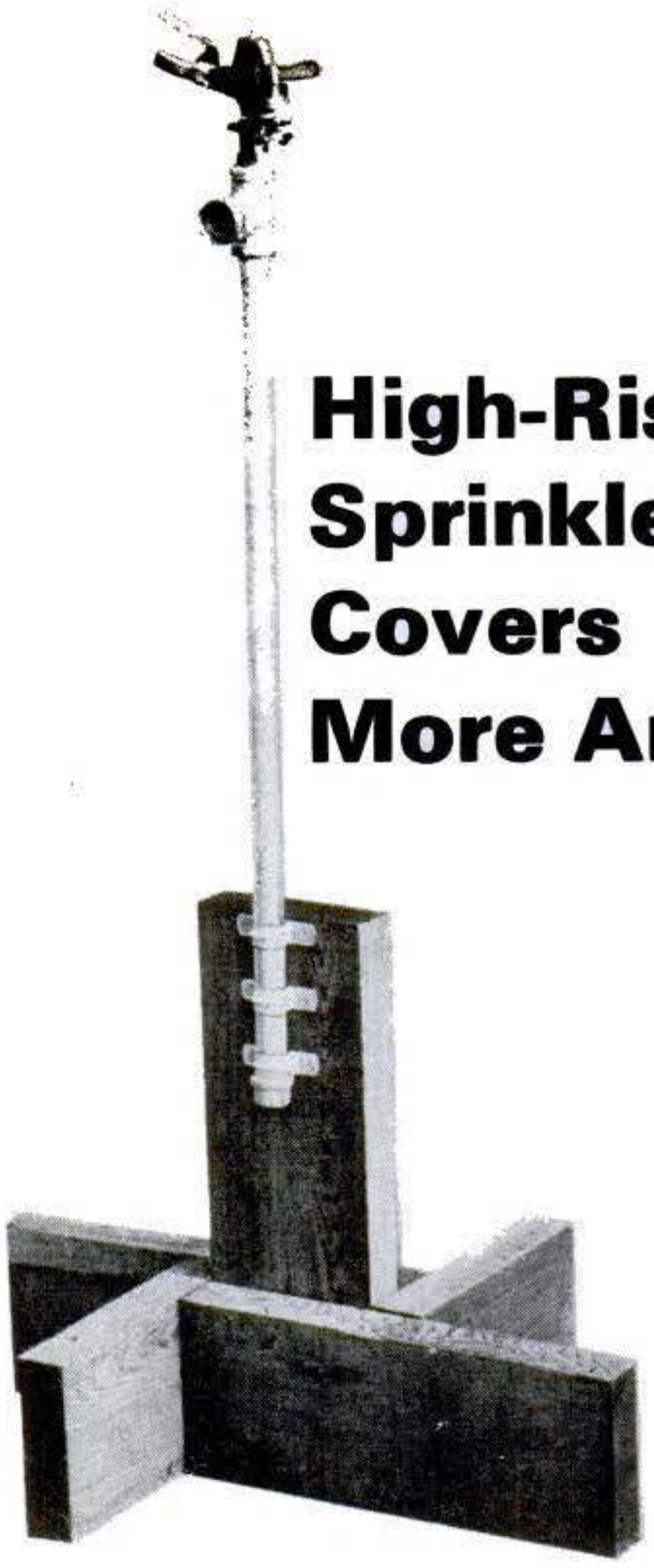

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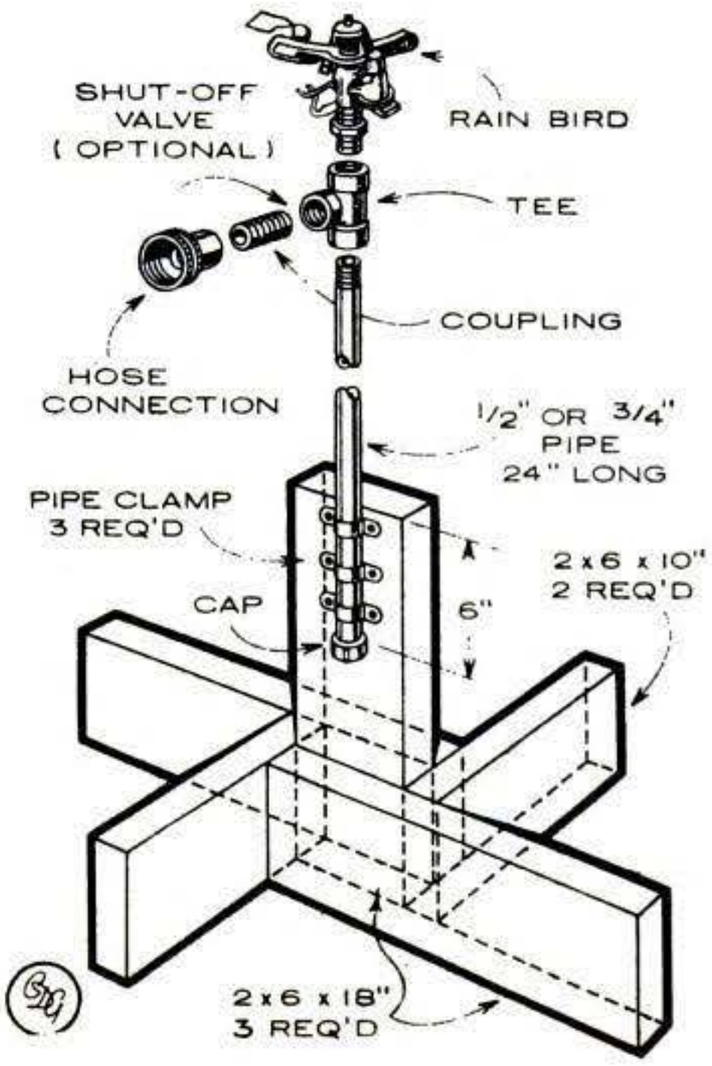

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Uncluttered look under hillside platform is feasible with new truss system.

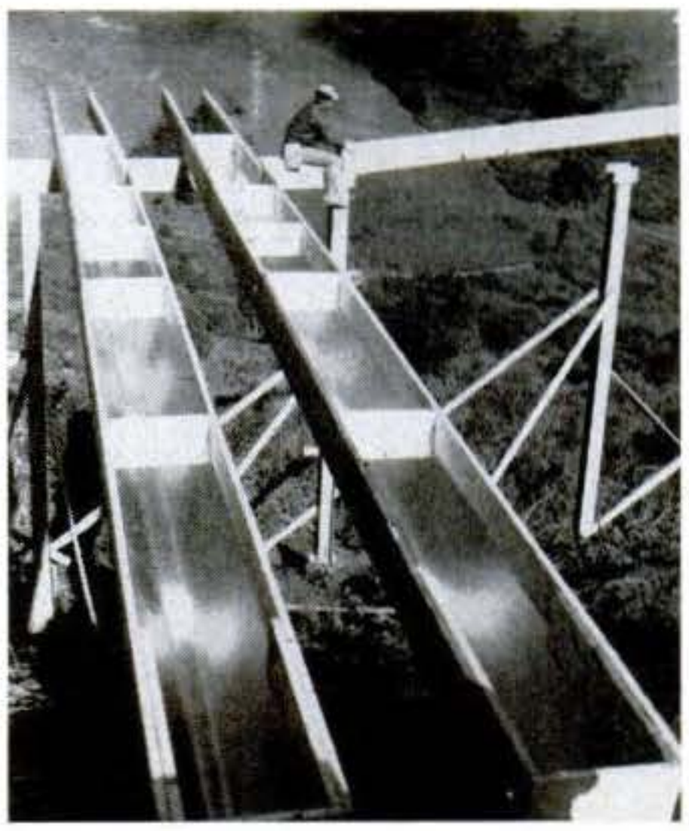
Super-Truss Design Trims Building Costs

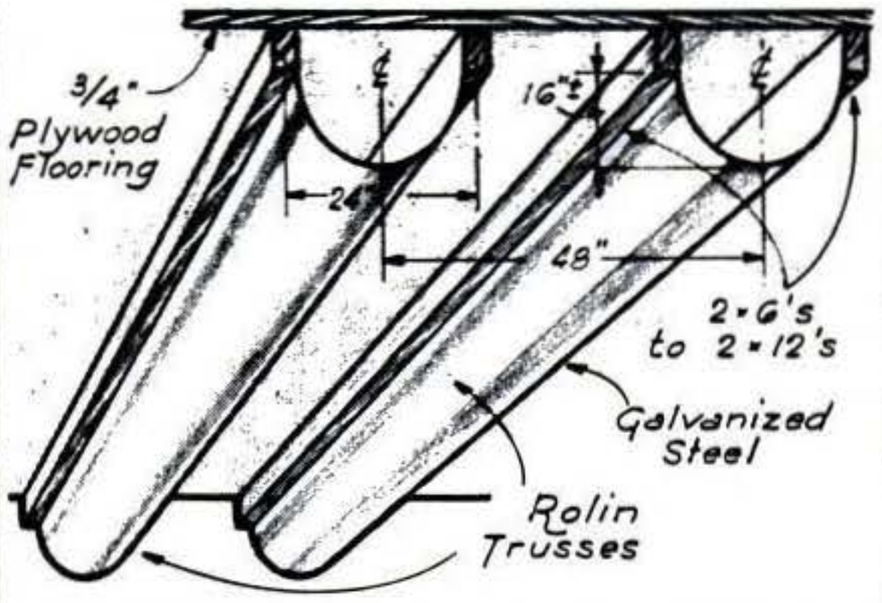
Builders in San Francisco's Bay Area are reducing cost and time for hillside construction with a new truss design. The truss, which combines sheet steel with wood beams, triples the strength of the wood joists for floor and roof support. This means builders can project long floors over steep slopes with much less structural support and site preparation.

Belgian-born engineer Etienne Rolin invented the new building component, so appropriately it's named the Rolin Truss. In his patented design, sheet steel is bowed and nailed between wood joists. The steel is in tension, the wood in compression. Result? A supertough truss system that enables builders to perform some spectacular tricks in a variety of applications.

In the hilly Bay Area, for example, platforms supporting car decks, homes, and apartments now jut over steep slopes with what appears to be a dangerous lack of structural underpinning. There's plenty of support, though; elimination of costly vertical posts and girders on slopes is saving builders from $600 for homes to thousands for buildings. Usually, a deck requires only a headwall, which takes the lateral load, and a single pair of support posts opposite on the downslope.

The truss system has Research Card approval from the International Conference of Building Officials, and a one-hour fire rating. Rolin-Tee Inc., 110 Belvedere St., San Rafael, Calif., the manufacturer, is licensing other franchises, gradually extending what until now has been a Bay Area enterprise.—*J. Williams*





Prefabricated trusses look like stock-feeding troughs but can support up to 110 pounds psf and loaded spans up to 65 ft. Single or double layers of 16- or 18-gauge galvanized sheet steel is bent and nailed to joists.

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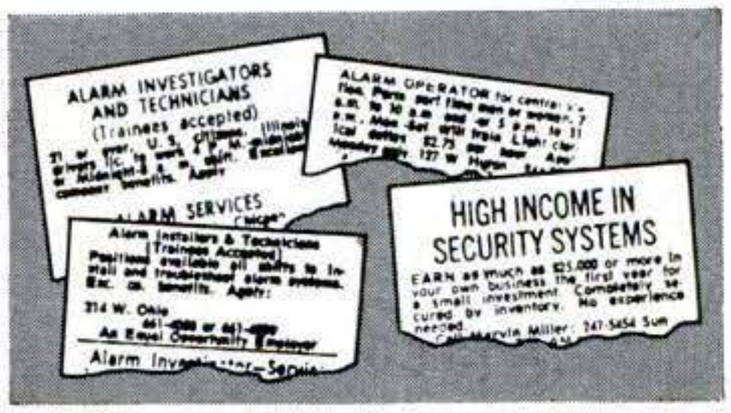

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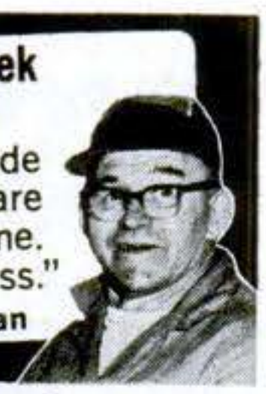

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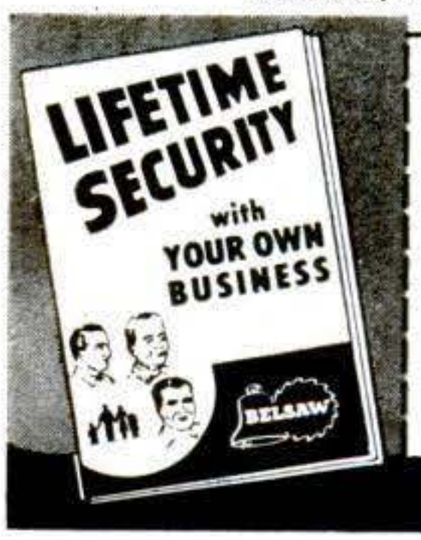

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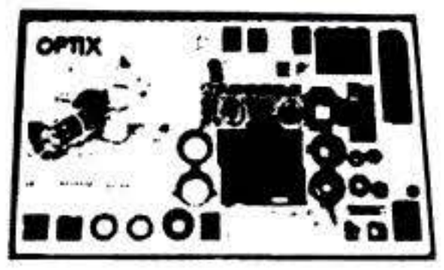

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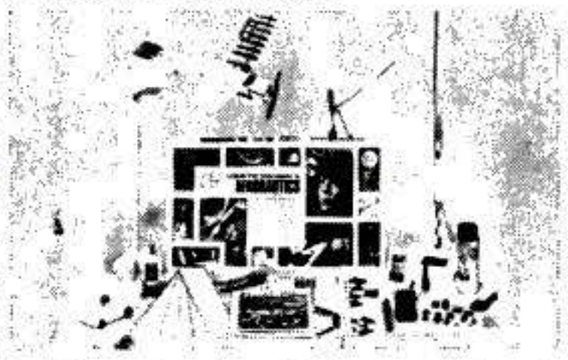

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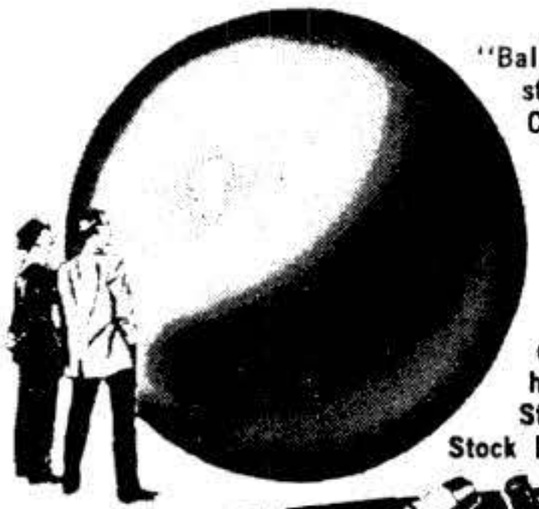

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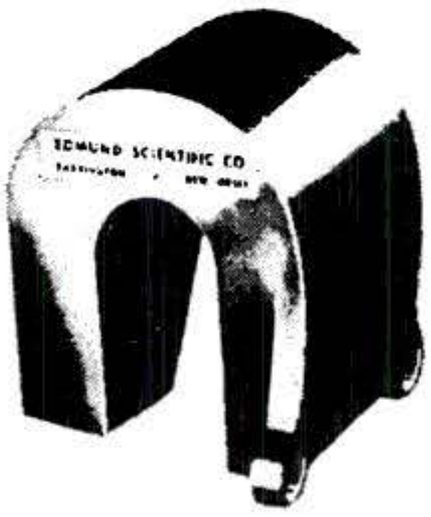

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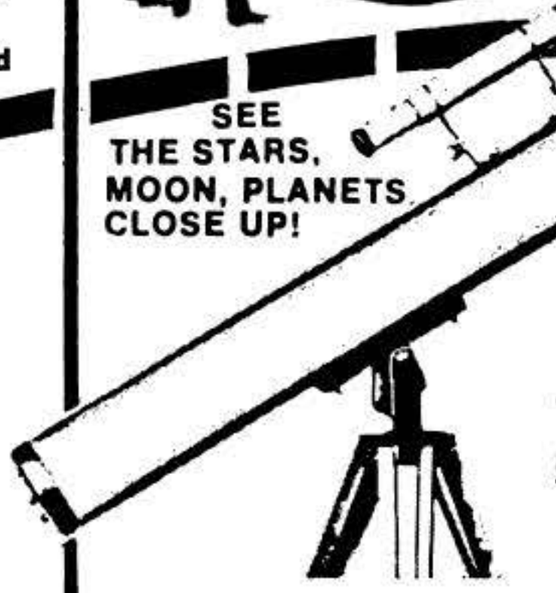

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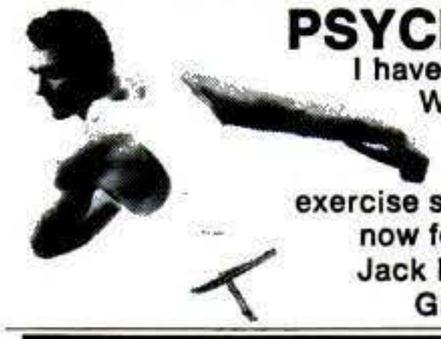

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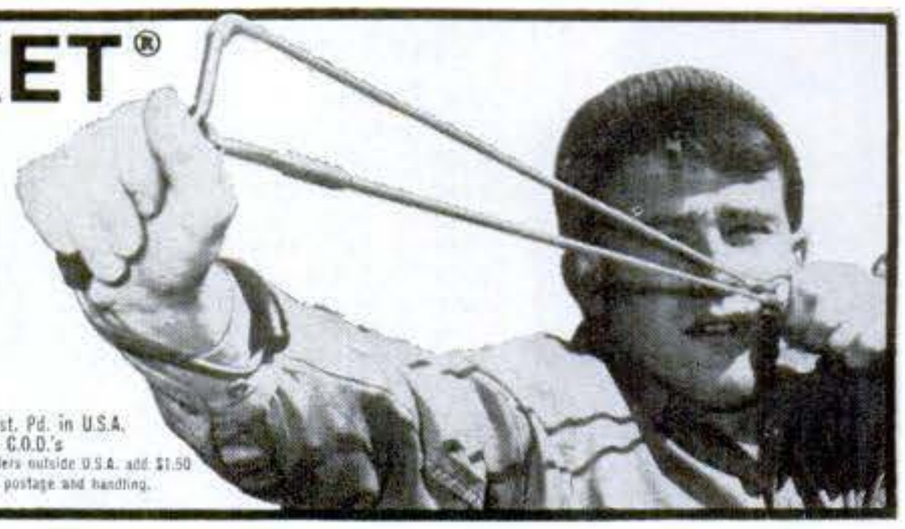

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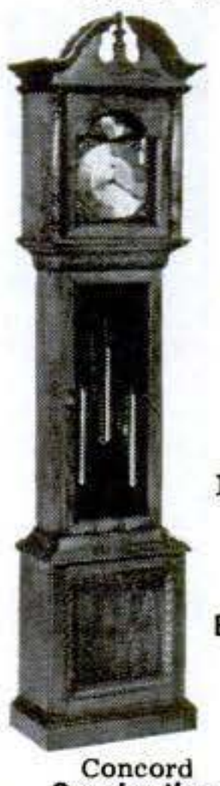

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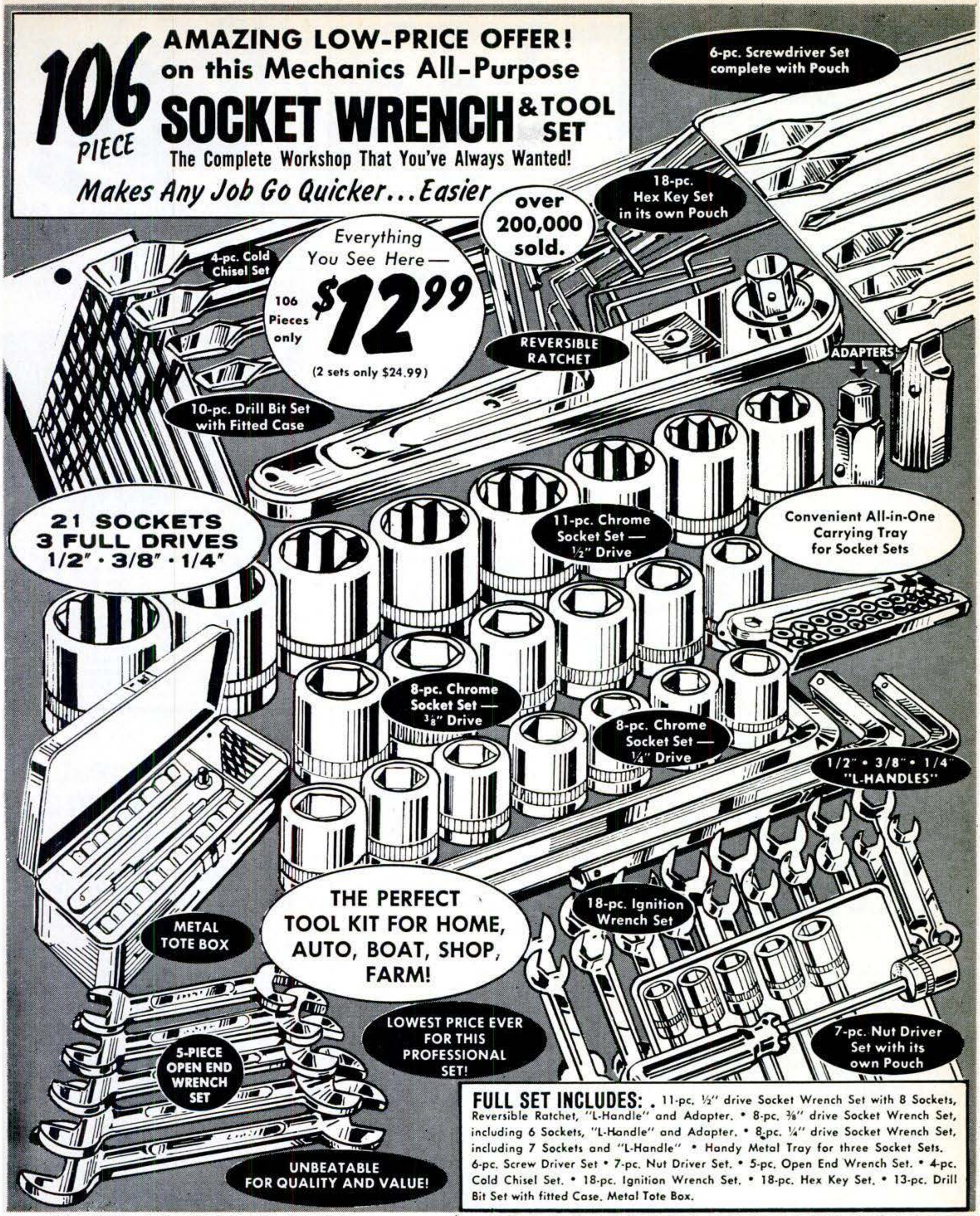

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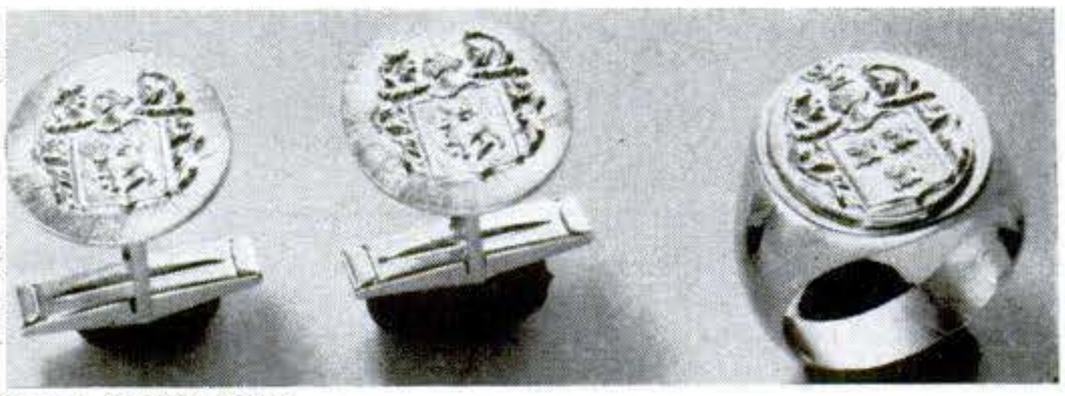

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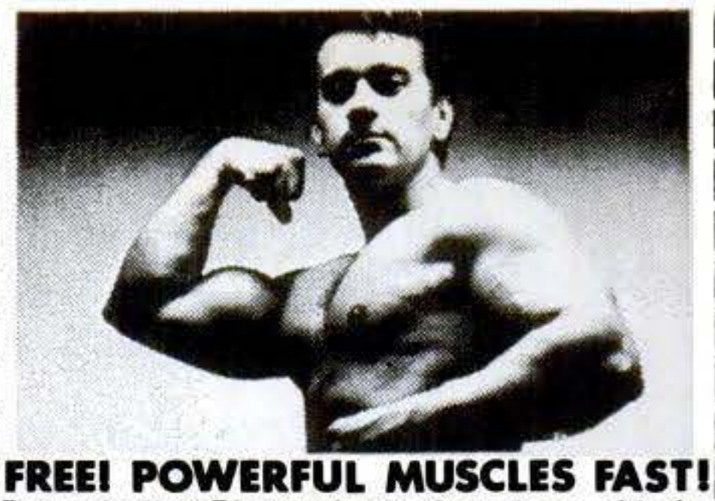

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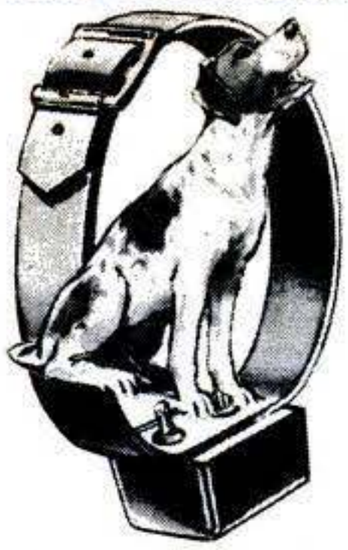

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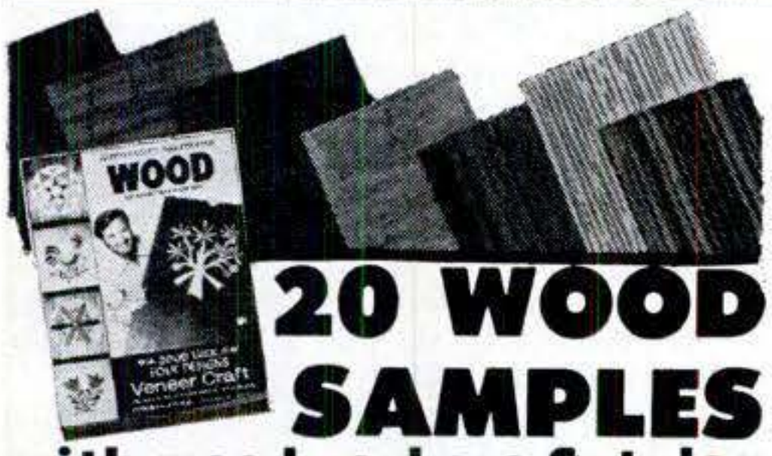

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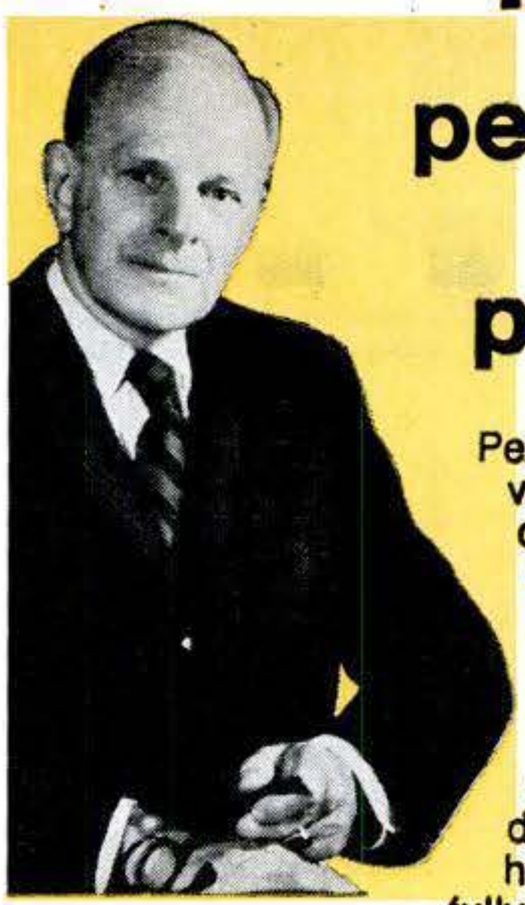

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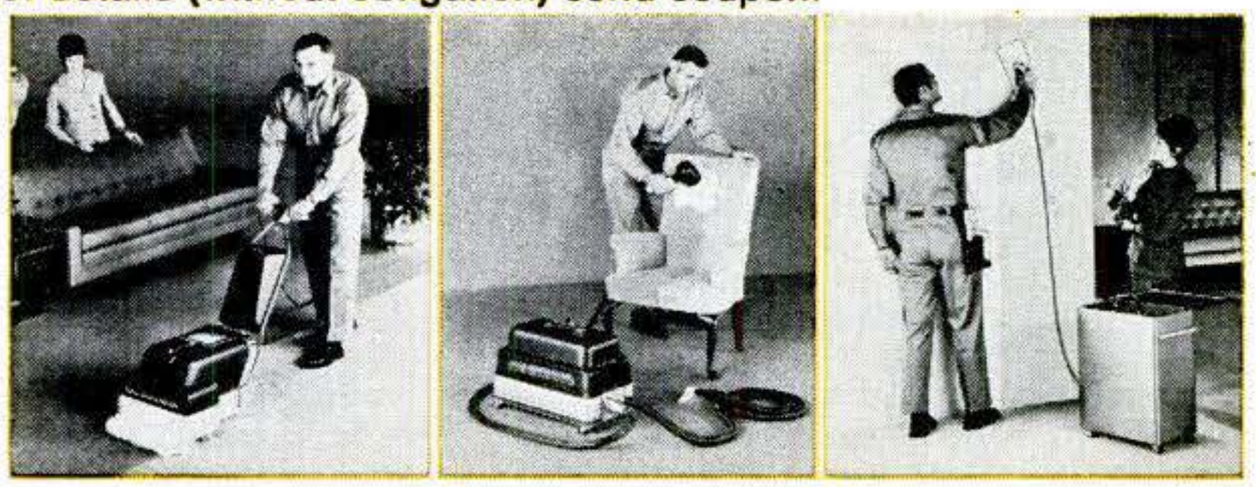

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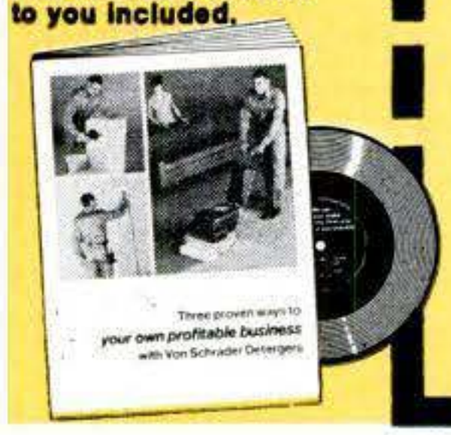

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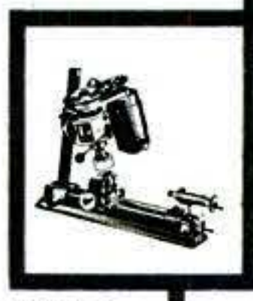

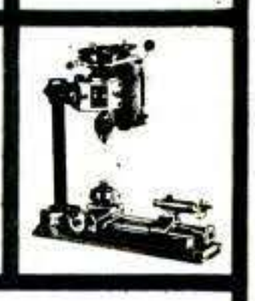

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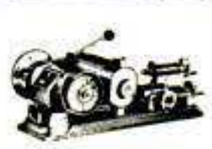

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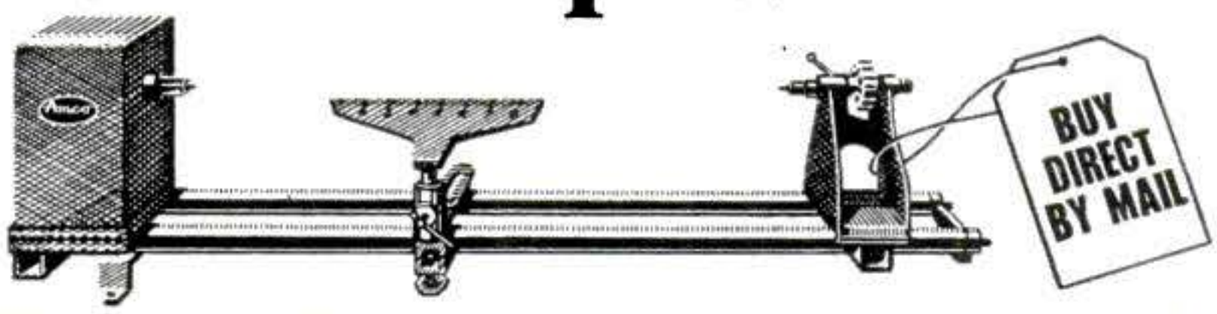

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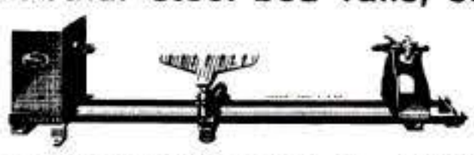

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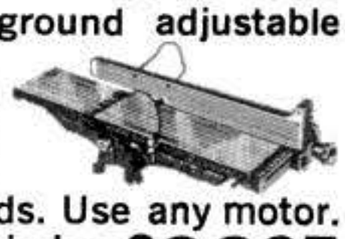

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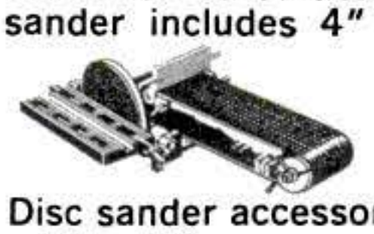

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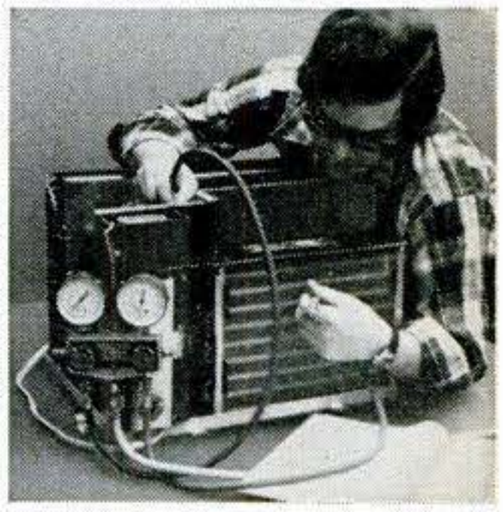

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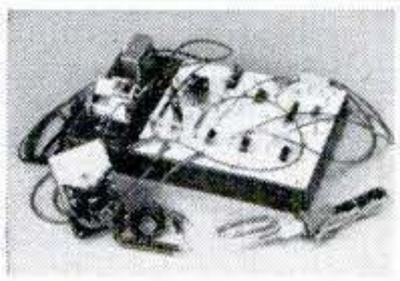

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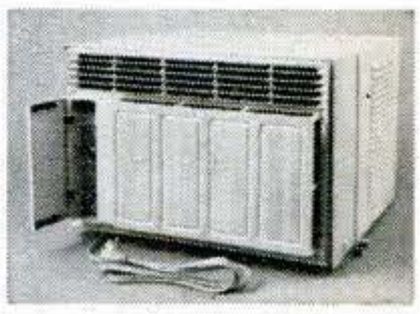

With the NRI Master Course, you receive a complete 5,000 BTU window air conditioner for troubleshooting and your personal use.

Resident Training at York Institute

Enrollees in the Master Course may take one week of advanced laboratory work at the famous York Institute at no extra cost. Resident training is an optional extra not required for your NRI diploma.

Choose One of Two Courses

NRI offers a basic course in Air Conditioning and Refrigeration, or the Master Course in Air Conditioning, Refrigeration, and Heating.

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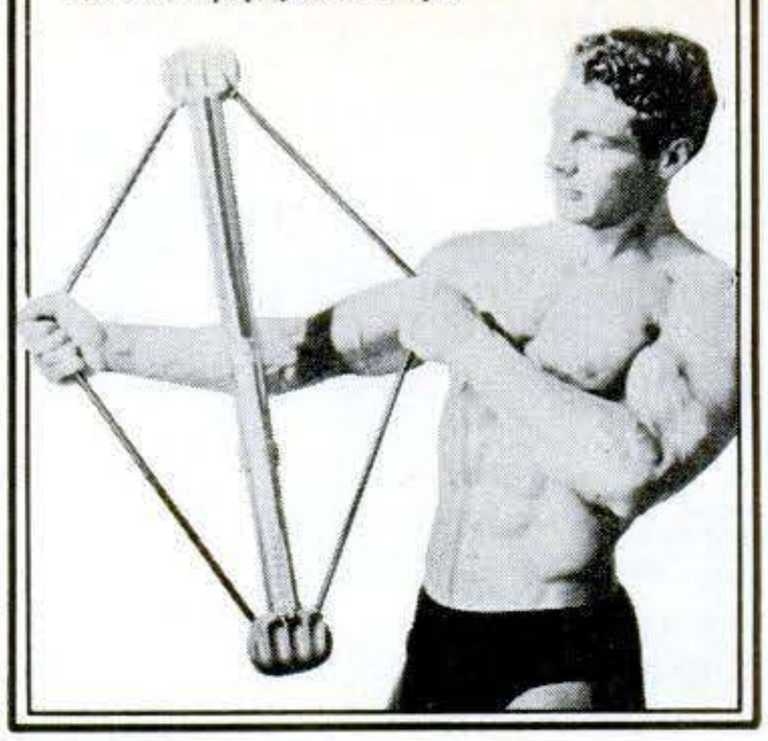
WHEN WERE YOU LAST REALLY FIT?

AN EXPERT TELLS YOU HOW TO GET BACK IN SHAPE.

John Texier, Mr. France demonstrates one of the easy, 7 second exercises that keep him in top physical shape.



Even if your're not particularly interested in building he-man muscles, you owe it to yourself to keep your body fit. It's a sad fact of today's life that many men ignore this point and end up regretting it when they find they've become "old men" long before their time. Thanks to modern exercising techniques, "keeping fit" is now easier than ever. John Texier, Mr. France and leading fitness specialist tells you how.

Q. *What does fitness mean?*

A. For normally healthy people, fitness is a simple matter of maintaining muscle tone through exercise—using your muscles often enough and hard enough to keep them healthy and trim.

Q. *How does lack of fitness show up?*

A. The answer depends on how old you are. In your teens or early twenties, it's largely a matter of physical development. Young men with pipe-stem arms and caved-in chests aren't fit. With older men the first signs are usually a roll of fat around the middle and a lack of pep and energy.

Q. *Can sports keep me fit?*

A. Yes, indeed, if practiced regularly and for long enough periods. Swimming, jogging, gymnastics, tennis, etc., can all help keep you fit provided you practice at least an hour three or four days a week—every week.

Q. *Isn't there an easier way?*

A. Yes, there's an outstanding home training method which I use and recommend. It's fast, easy and guaranteed to give results.

Q. *What's it called?*

A. Bullworker training. It's based on Isometric techniques which have been proven to increase strength faster than sports or conventional calisthenics.

Q. *How long does it take?*

A. The 7-exercise introductory program requires only 70 seconds of exercise per day. The complete advanced training program takes about 5 minutes.

Q. *When do the results start?*

A. With the Bullworker, you can begin to see and measure positive results from the very first day! Isometric Bullworker training can increase your power at the amazing rate of up to 4% per week!

Built-in Powermeter
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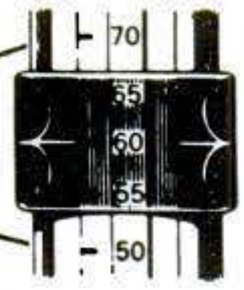

Q. *But it's hard work, isn't it?*

A. Absolutely not! That's the outstanding advantage of Isometric training...it's so amazingly easy! Each "Staticpower" Isometric exercise takes only 7 seconds, and you barely have to move.

Q. *Is there an age limit?*

A. Generally speaking, men between 15 and 65 in good general health can expect to benefit from fitness and strength building training. Young men should use Bullworker to improve their muscular development: broad, powerful shoulders—rippling biceps—a deep, manly chest.

Men in their thirties should use Bullworker to maintain peak physical form and for toning-up the muscles of their abdomen, chest, shoulders and upper arms.

From 45 on, Bullworker should be used to regain and maintain a youthful vigorous body that belies the passing years. I've seen lots of Bullworker users in their fifties with more energy, power, and vigor than many younger men.

Q. *How can I find out more about the Bullworker.*

A. I understand that the American distributor is now offering the Bullworker on a two-week-free-home trial basis. If you're interested in getting back into shape fast, I recommend you contact the distributor for full details.

John Frelin shows how he increased his biceps by 2", filled out his chest by 4", his thighs by 1¼" in just a few weeks of Bullworker training.

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I'd like to give this to my fellow men...

while I am still able to help!

I was young once, as you may be — today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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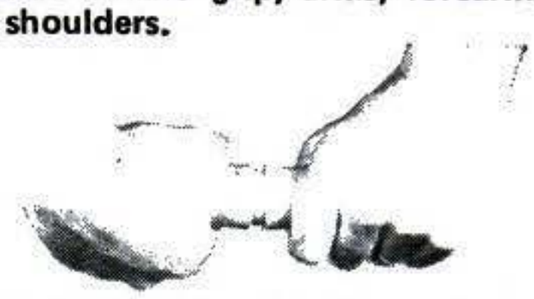

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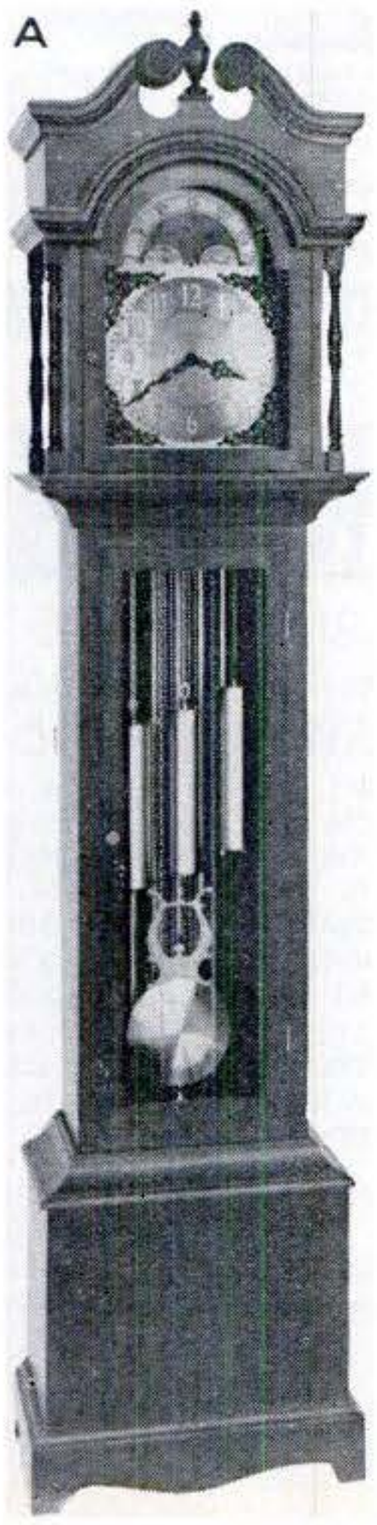

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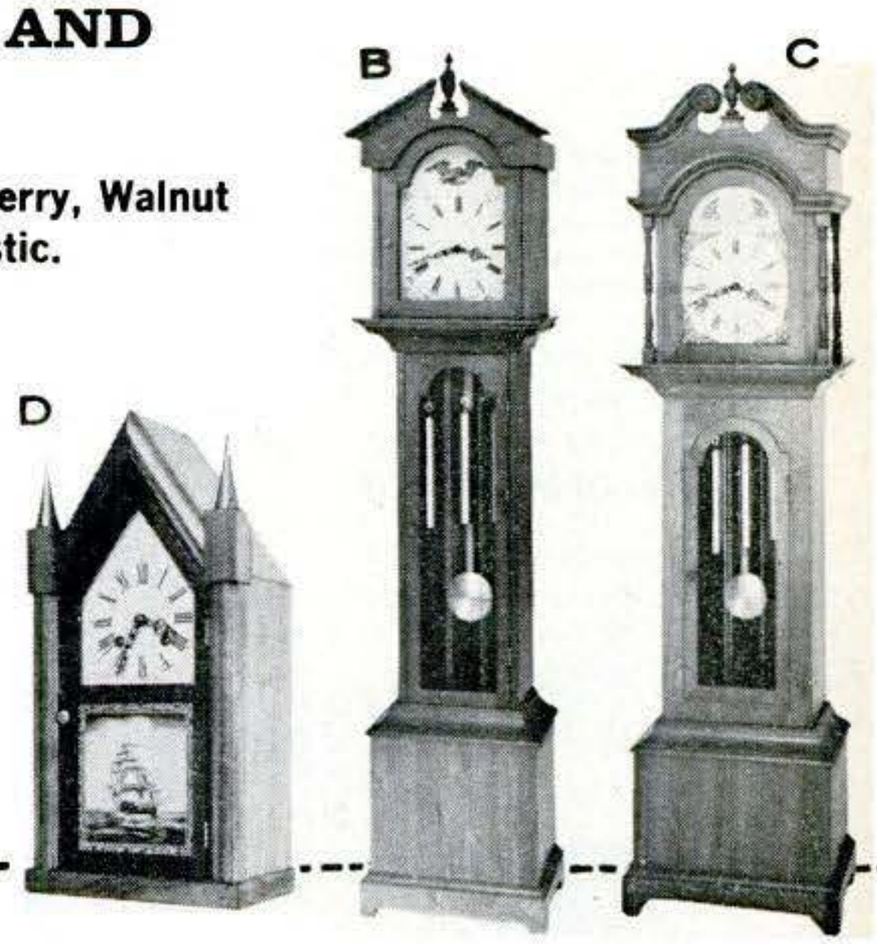

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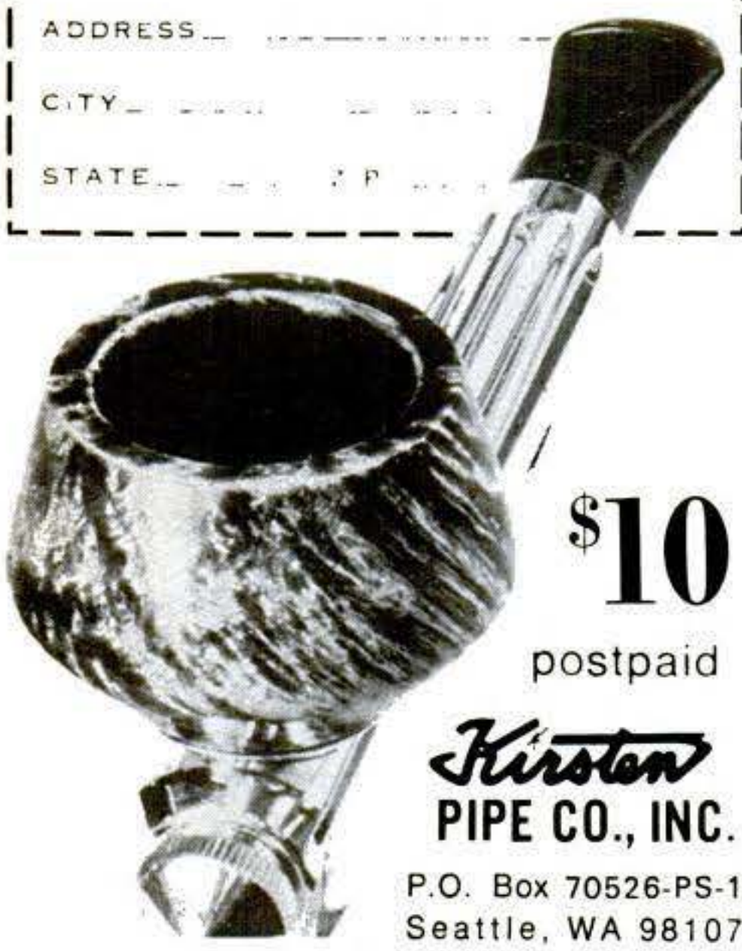

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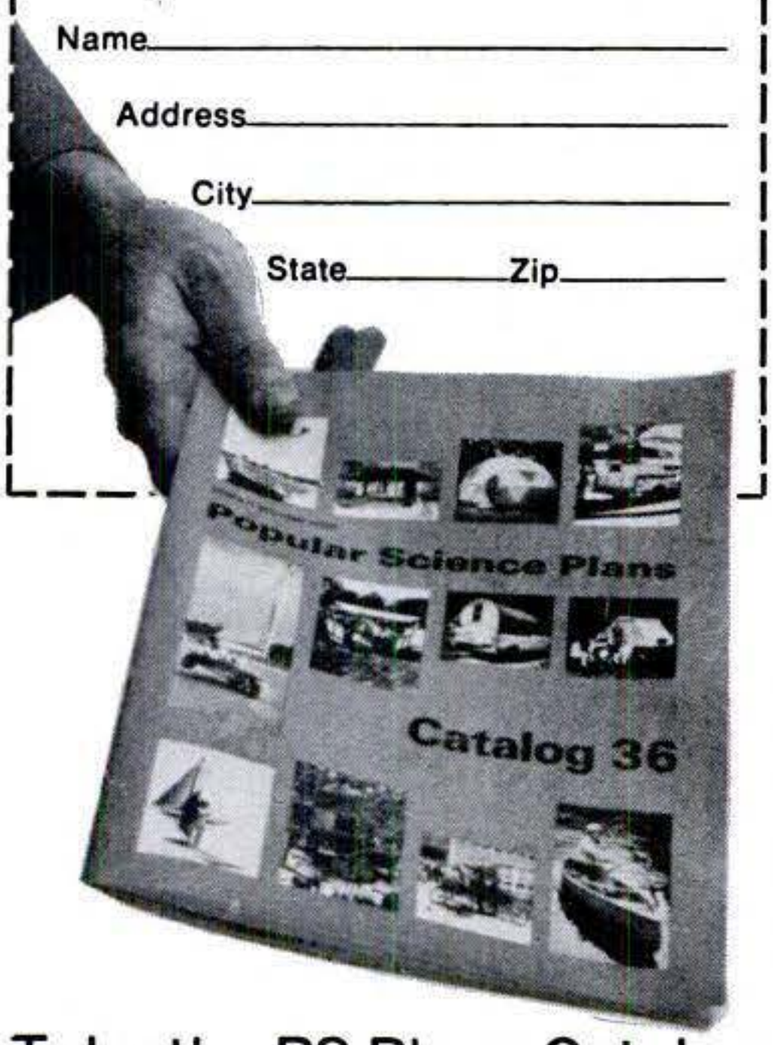

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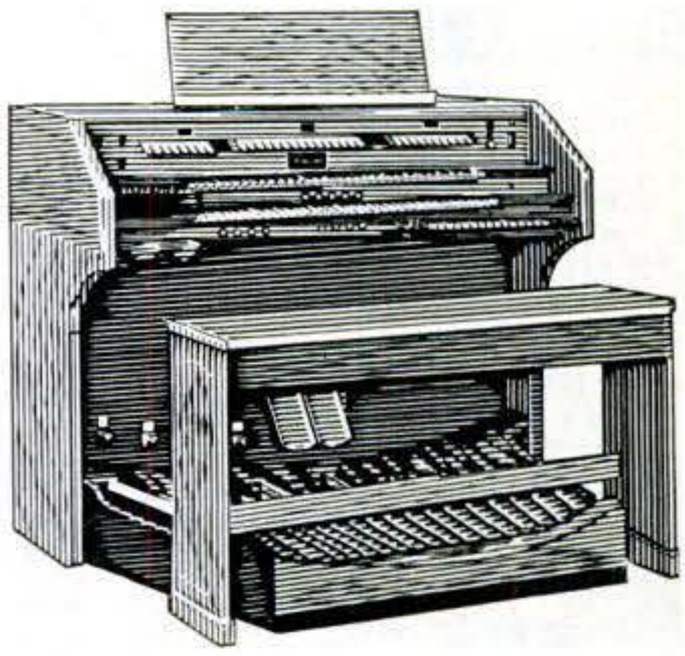

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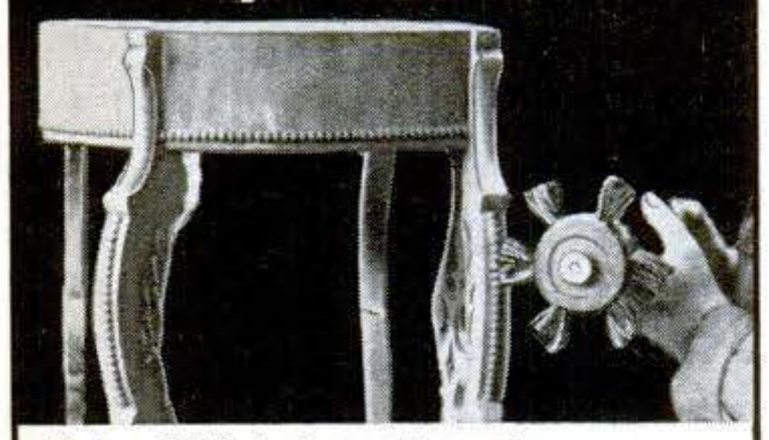

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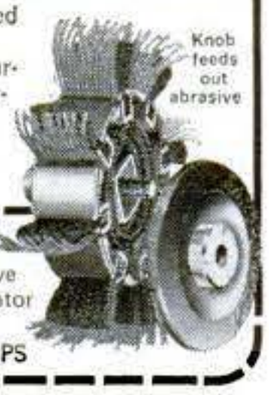

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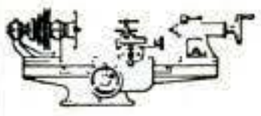

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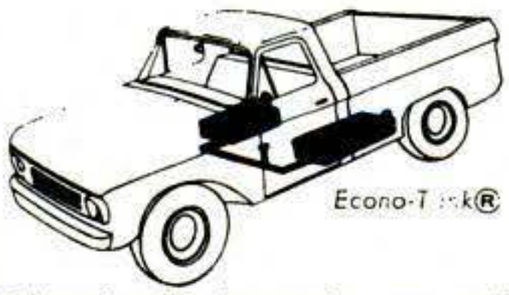

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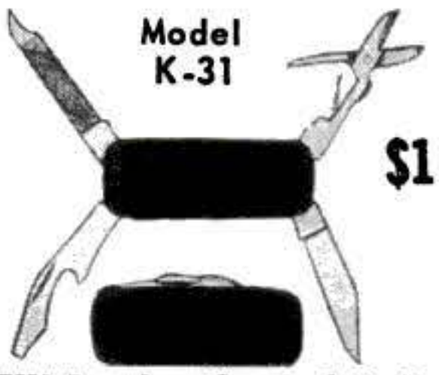

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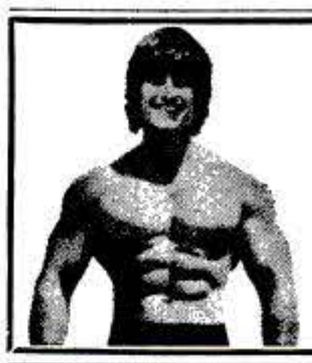

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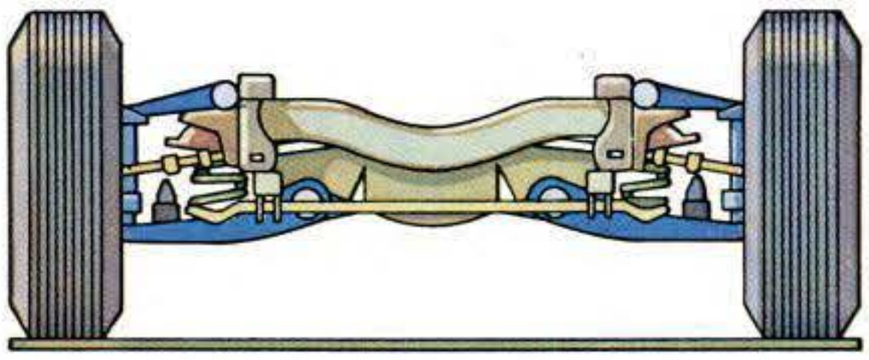

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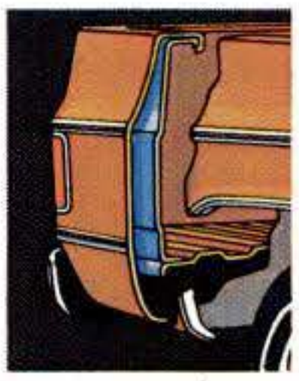
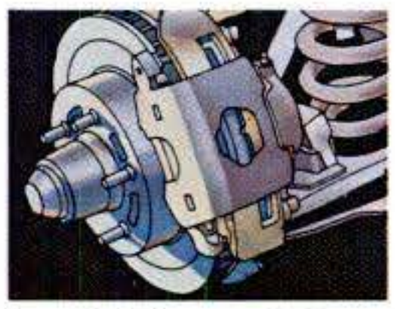
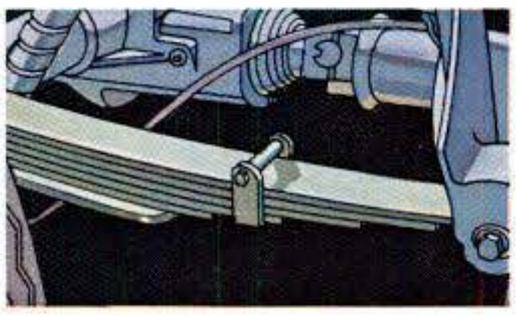


Tough double-wall construction. Cheyenne pickups are built to last. With strong double-wall construction in the cab doors, roof, sills and front fenders. Fleetside cargo box is double-walled from top to bottom. Even the tailgate is made from two walls of steel for strength.



Standard Front Disc Brakes are part of an improved new system with brake size and design matched to truck size and capacity; heavier duty pickups get heavier duty brakes automatically.



Load Control rear leaf springs are 2-stage design. As the load weight increases, so does spring support. Result: a smooth ride without a load, strong support when a load is added.

Building a better way Chevrolet **to serve the U.S.A.**

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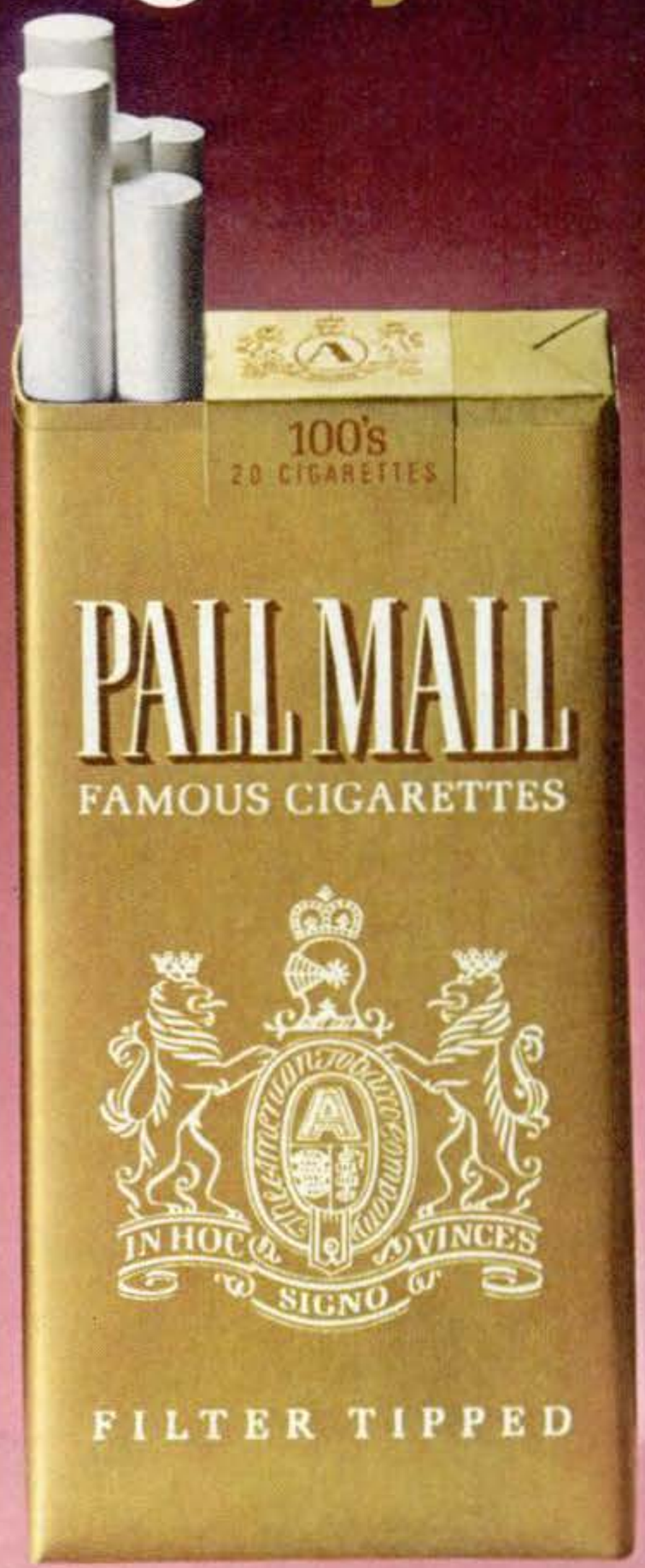
Yes, longer yet milder



PALL MALL
GOLD 100's

Longer length, milder taste

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

20 mg. "tar" 1.4 mg. nicotine av. per cigarette, FTC Report FEBRUARY '73.

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